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REPORT

OF THE

TESTS OF METALS

AND OTHER MATERIALS

FOR

INDUSTRIAL PURPOSES

MADE WITH THE

UNITED STATES TESTING MACHINE AT WATERTOWN
ARSENAL, MASSACHUSETTS, DURING THE
FISCAL YEAR ENDED JUNE 30,

1908.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1909.

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JUN 22 1910

From the
U. S. Government.

WAR DEPARTMENT,

Document No. 337,

Office of the Chief of Ordnance.



WAR DEPARTMENT,
Washington, January 12, 1909.

SIR: I have the honor to transmit herewith a letter from the Chief of Ordnance, U. S. Army, bearing this date, submitting, for transmission to Congress, as required by law, the report of the commanding officer of Watertown Arsenal of Tests of Iron and Steel and other Material for Industrial Purposes made at that arsenal during the fiscal year ended June 30, 1908.

Very respectfully,

LUKE E. WRIGHT,
Secretary of War.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

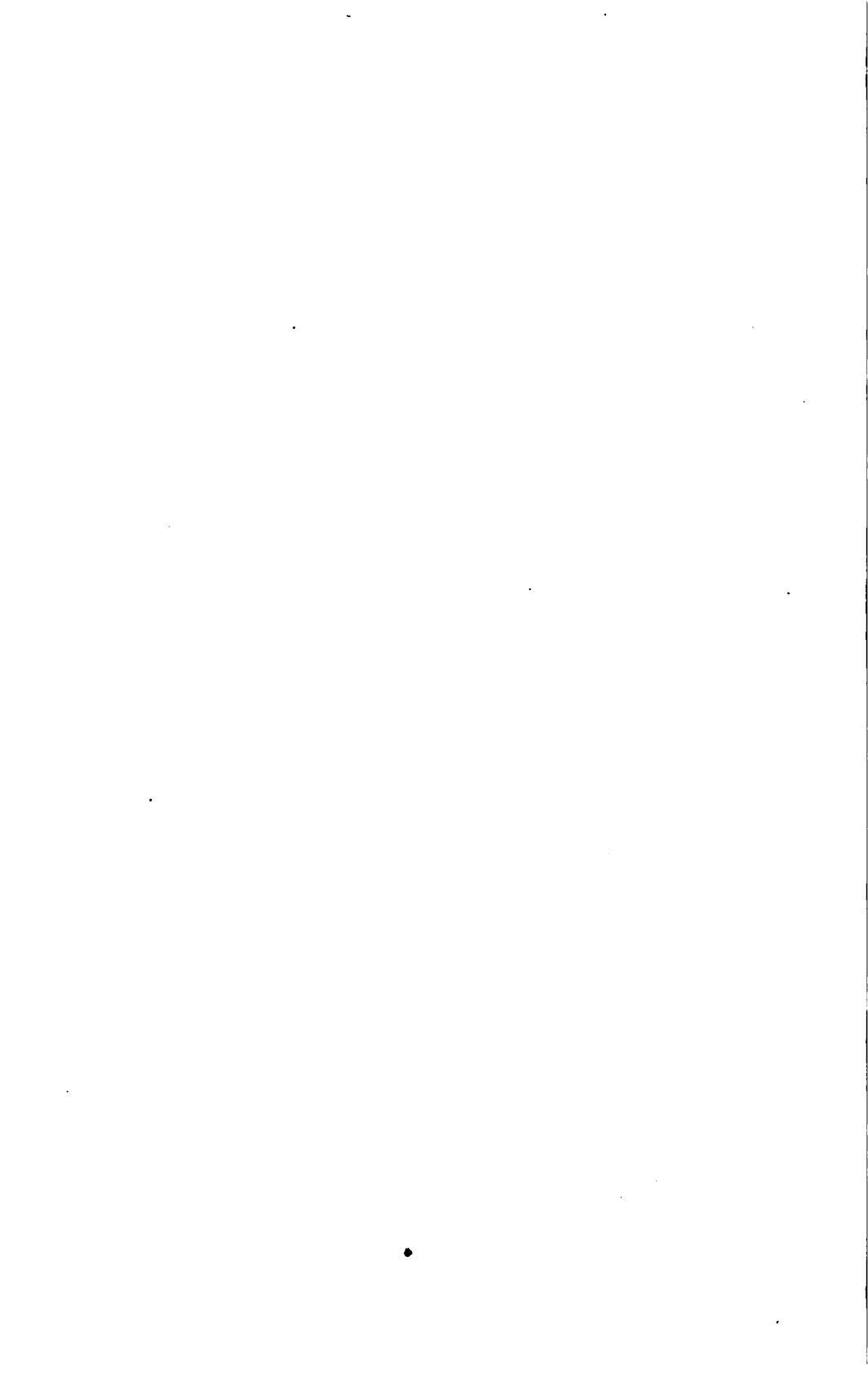
WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ORDNANCE,
Washington, January 12, 1909.

SIR: I have the honor to submit, for transmission to Congress, as required by law, the report of the commanding officer of Watertown Arsenal, of Tests of Iron and Steel and other Material for Industrial Purposes made at that arsenal during the fiscal year ended June 30, 1908 (O. O. File 18563).

Very respectfully,

WILLIAM CROZIER,
Brig. Gen., Chief of Ordnance.

The honorable the SECRETARY OF WAR.



**WATERTOWN ARSENAL,
Watertown, Mass., December 31, 1908.**

SIR: I have the honor to submit herewith the annual report of tests of iron and steel and other materials made at this arsenal during the fiscal year ended June 30, 1908.

The total number of specimens tested during the year was classified as follows:

Gun specimens.....	22
For Ordnance Department.....	2, 191
For other government departments.....	120
Investigative tests.....	467
Tests for private parties.....	1, 085
Total.....	3, 885

The receipts and expenditures were as follows:

Amount appropriated for testing machine and testing work.....	\$35, 000. 00
Received from private parties during the year.....	1, 070. 36
Total received.....	36, 070. 36
Amount expended for services and labor.....	8, 985. 90
Amount expended for light, power, tools, implements, and materials for test.....	26, 061. 94
Deposited to credit of Treasurer United States.....	1, 022. 52
Total expended.....	36, 070. 36

Two principal series of tests were inaugurated—a series on steel ingots and derivative shapes and one on steel compression members. In carrying on these tests the laboratory has been aided by two committees, the members of which are as follows:

Committee on steel ingots and derivative shapes.—Maj. C. B. Wheeler, commanding officer, Watertown Arsenal, Watertown, Mass. (ex officio); Mr. James E. Howard, engineer of tests, Watertown Arsenal, Watertown, Mass. (ex officio); Mr. D. D. Carothers, chief engineer, Baltimore and Ohio Railroad, Baltimore, Md.; Mr. James Christie, consulting engineer, Wissahickon, Pa.; Mr. Charles S. Churchill, chief engineer, Norfolk and Western Railway, Roanoke, Va.; Dr. Charles B. Dudley, chemist, the Pennsylvania Railroad, Altoona, Pa.; Mr. E. F. Kenney, metallurgical engineer, Cambria Steel Company, Johnstown, Pa.; Prof. Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.; Mr. J. P. Snow, bridge engineer, Boston and Maine Railroad, Boston, Mass.; Mr. A. A. Stevenson, vice-president, Standard Steel Works, Philadelphia, Pa.; Mr. S. M. Vauclain, superintendent, Baldwin Locomotive Works, Philadelphia, Pa.; Mr. William R. Webster, consulting engineer, Philadelphia, Pa.; Mr. F. W. Wood, president, Maryland Steel Company, Sparrows Point, Md.

Committee on structural shapes, compression members.—Maj. C. B. Wheeler, commanding officer, Watertown Arsenal, Watertown, Mass. (ex officio); Mr. James E. Howard, engineer of tests, Watertown Arse-

nal, Watertown, Mass. (ex officio); Mr. C. W. Bryan, division contracting manager, American Bridge Company of New York, Manhattan, N. Y.; Mr. Lincoln Bush, chief engineer, Delaware, Lackawanna and Western Railroad, Hoboken, N. J.; Mr. H. W. Hodge, Boller & Hodge, consulting engineers, Manhattan, N. Y.; Mr. F. C. Kunz, chief engineer, bridge and construction department, the Pennsylvania Steel Company, Steelton, Pa.; Prof. Gaetano Lanza, professor of theoretical and applied mechanics, Massachusetts Institute of Technology, Boston, Mass.; Prof. Edgar Marburg, professor of civil engineering, University of Pennsylvania, Philadelphia, Pa.; Mr. Leon S. Moisseiff, engineer in charge, Henry Hudson memorial bridge, Manhattan, N. Y.; Prof. George F. Swain, professor of civil engineering, Massachusetts Institute of Technology, Boston, Mass.; Mr. William R. Webster, consulting engineer, Philadelphia, Pa.; Mr. Paul L. Wolfel, chief engineer, McClintic-Marshall Construction Company, Pittsburg, Pa.

The present report embodies certain of the results of these two principal series of tests, the work on which is being continued during the present fiscal year.

Very respectfully, your obedient servant,

C. B. WHEELER,

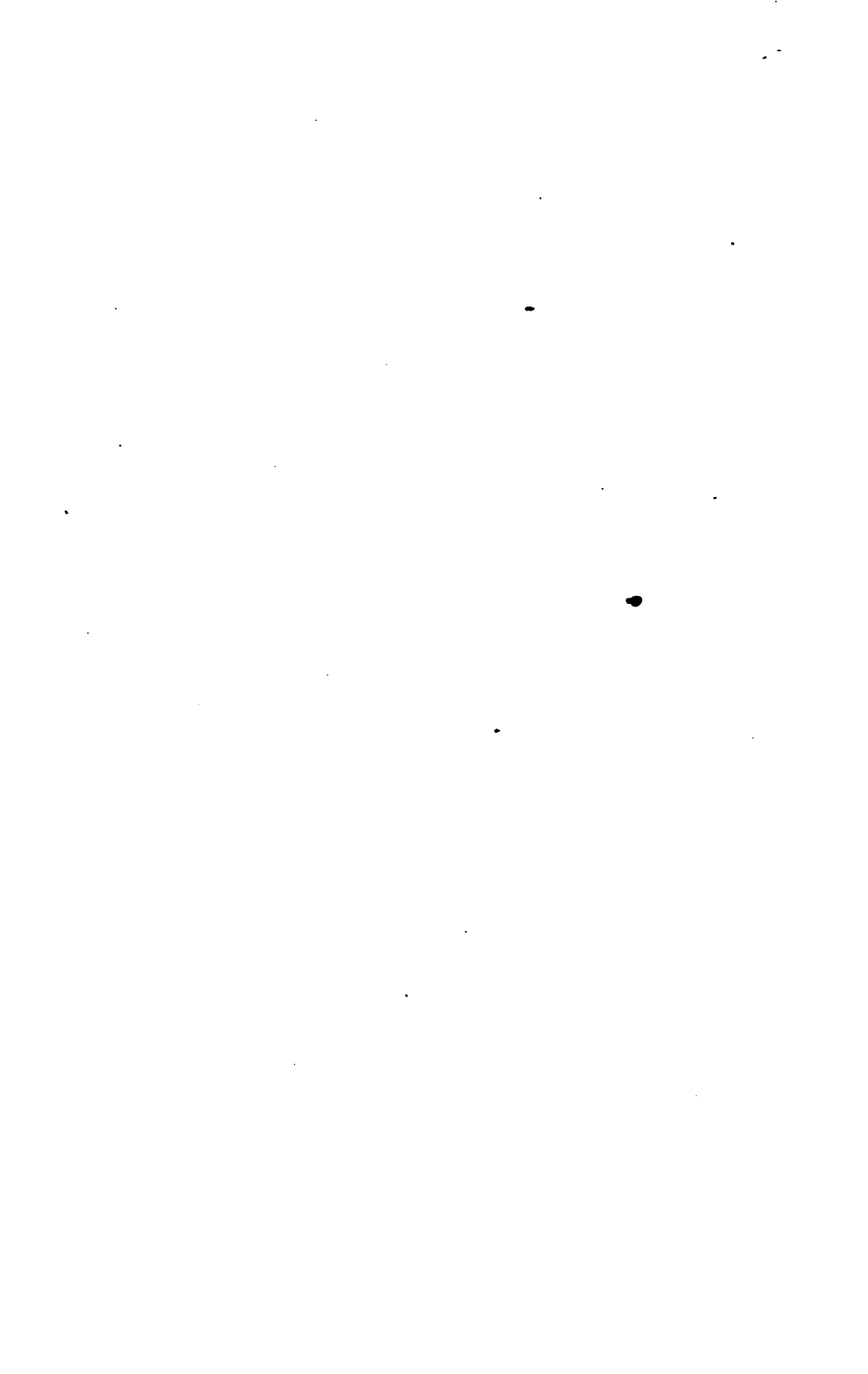
Major, Ordnance Department, U. S. Army, Commanding.

The CHIEF OF ORDNANCE, U. S. ARMY,

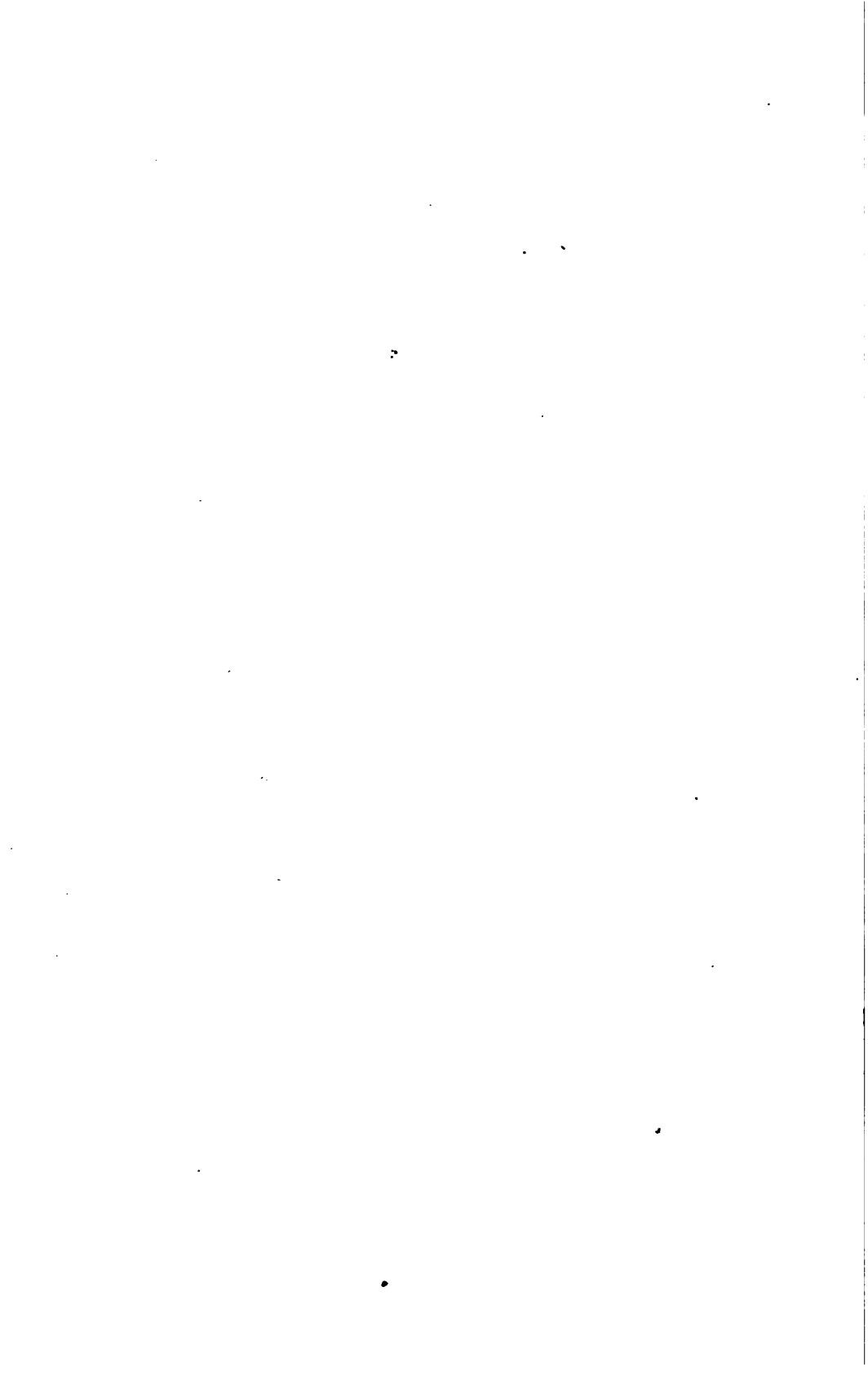
Washington, D. C.

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REPORT
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MADE WITH THE
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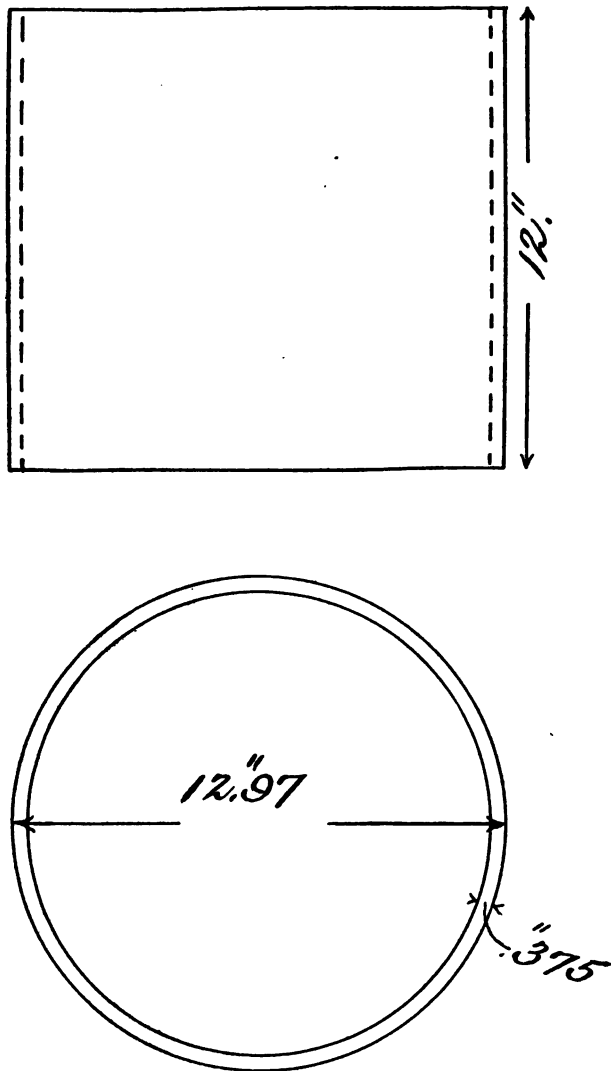


12-INCH RIFLE NO. 41.

**HYDROSTATIC, MANDREL, AND TENSILE TESTS
AND INITIAL STRAIN DETERMINATIONS.**

HYDROSTATIC TEST OF SECTION OF TUBE OF 12-INCH RIFLE NO. 41,
MODEL OF 1888, M 1½.

This tube was ruptured at Fort Heath, Mass., June 25, 1907.
Section taken from tube, in front of the ruptured part:



Tangential stress at the bore computed by the formula:

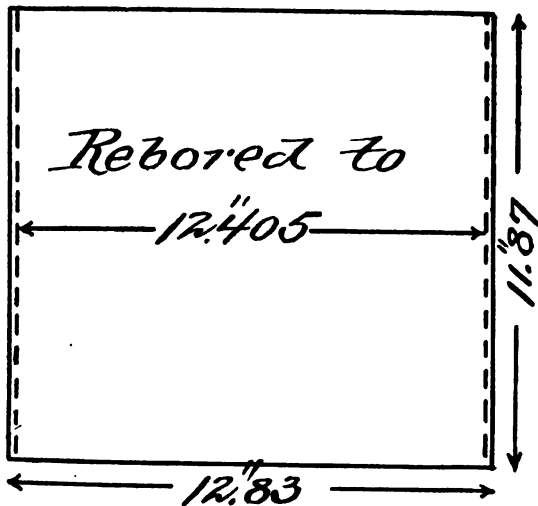
$$\phi = \frac{P \times (4R_1^2 + 2R_0^2)}{3(R_1^2 - R_0^2)}$$

Interior pressure per square inch.	Tangential stress at bore per square inch.	Permanent set in diameter.	Remarks.
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	
325	5,600	0.	Initial load.
2,600	44,600	0.	
325	5,600	0.	Rapid yielding began.
2,728	40,800		
2,800	48,000		
325	5,600	.06	
2,900	49,700		
325	5,600	.10	
3,000	51,400		
325	5,600	.11	
3,200	54,900		
325	5,600	.18	
3,248	55,700		
325	5,600	.22	

Test discontinued.

Original circumference, 40''.75; circumference at time of discontinuing test, 41''.45. Circumferential elongation, 0''.70 = 1.7 per cent.

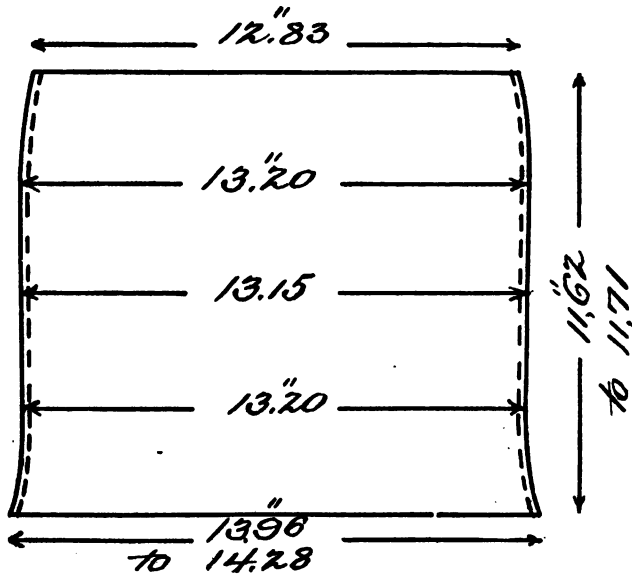
Cylinder removed from test fixture and bored out to 12''.405 interior diameter; outside turned down to 12''.83 diameter.



Cylinder returned to the testing fixture and test resumed. The metal of the cylinder renewed stretching under the effect of an interior pressure of 1,950 pounds per square inch = 58,600 pounds per square inch tangential stress at the bore.

Interior pressures were advanced to 2,378 pounds per square inch = 71,400 pounds per square inch tangential stress at the bore, referred to the reduced dimensions above given.

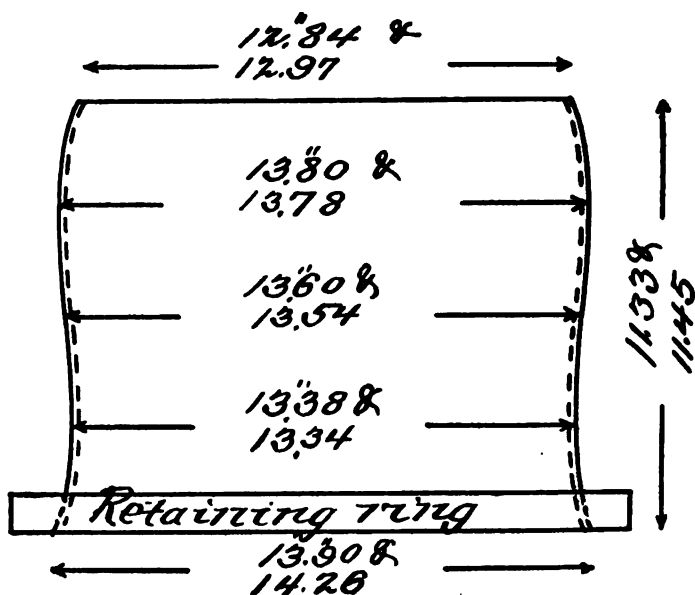
Under this load the deformation of the cylinder reached such an extent that the hydraulic packing blew out at the lower end. Cylinder was removed from the fixture, its present shape being shown by the sketch herewith.



The metal showed numerous streaks on both outside and inside cylindrical surfaces, but their appearance was unchanged by the test.

Cylinder was again placed on test fixture and subjected to an additional test. The larger end was provided with a retaining ring to restrict further enlargement, so that the opposite end and middle part of the cylinder might be expanded, the large increase in diameter at the lower end so far reducing its resistance that the walls in this vicinity would necessarily continue to yield, the smaller end remaining stationary.

An interior pressure of 2,663 pounds per square inch was applied, which caused further expansion of the walls of the test cylinder. The hydraulic packing finally blew out, the test then being discontinued. The final, distorted shape of the cylinder is shown by the sketch herewith.



The maximum extension of the exterior diameter of the cylinder was as follows:

Final mean diameter at lower end.....	14''.08
Diameter to which cylinder had been turned down after first test.....	12''.83

Expansion.....	1''.25
Expansion of first test, before turning down.....	0''.22

Total.....	1''.47
------------	--------

Per cent.

0''.22+12''.97=.....	1.7
1''.25+12''.83=.....	9.7

Total expansion at lower end.....	11.4
-----------------------------------	------

Expansion at middle of length:

0''.74+12''.83=.....	5.8
Expansion of first test.....	1.7

Total expansion at middle of length.....	7.5
--	-----

Expansion at upper (small) end:

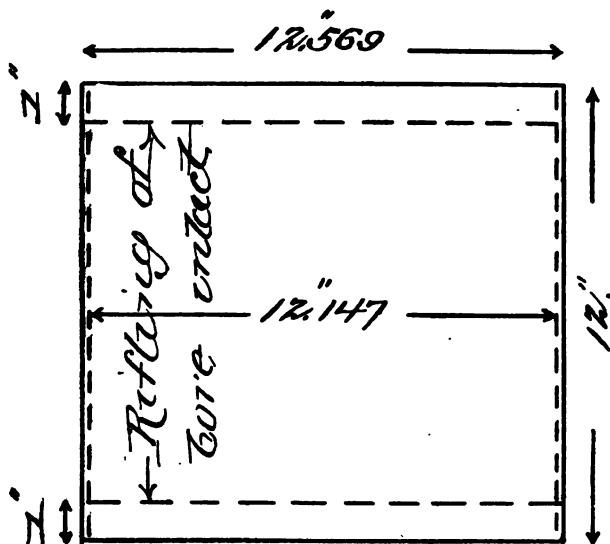
0''.07+12''.83=.....	0.5
Expansion of first test.....	1.7

Total expansion at upper end.....	2.2
-----------------------------------	-----

Maximum tangential stress at bore due to interior pressure of 2,663 pounds per square inch, referred to dimensions of rebored and

returned cylinder (12".83 exterior diameter and 12".405 interior diameter) = 80,000 pounds per square inch.

Section taken from breech portion of tube to the rear of the fractured part.



Specimen prepared for testing with rifling of bore left intact, excepting that at ends of the test cylinder the lands were bored out for a length of 1 inch for the purpose of affording smooth seats for the hydraulic packings.

Cylinder burst under an interior pressure of 1,332 pounds per square inch.

Ultimate strength, tangential stress at surface of bore (at bottom of grooves) = 39,500 pounds per square inch.

Line of fracture followed one edge of a land at its junction with the groove. Appearance of fracture, fine granular. Along the middle of the length of the fractured surface, on the edge next the bore, the metal was dark colored for a depth of ".01 to ".02, taken to indicate a crack existing in the bore before the test began.

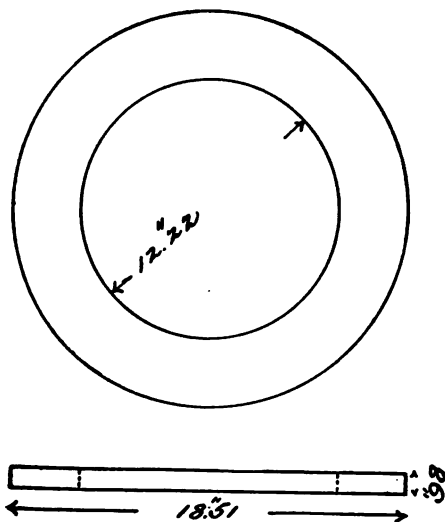
The metal was under internal strains of tension at the bore tangentially, and after rupture the ends sprung together, overlapping a length of 1".28.

NOTE.—In turning down the tube to the size of the test cylinder the metal appeared to be free from streaks until the diameter was reduced from 20".82 down to 18 $\frac{1}{2}$ ". Streaks were visible when at 17 $\frac{3}{4}$ " diameter, and remained about the same at 16 $\frac{1}{2}$ " diameter. When turned to smaller diameters the streaks were less numerous, but remained visible at the final exterior diameter of the cylinder as tested.

H. Doc. 1322, 60-2—2

**MANDREL TESTS OF SECTIONS OF TUBE OF 12-INCH RIFLE NO. 41,
MODEL OF 1888, M 1½.**

Section from tube adjacent to hydrostatic test cylinder taken from tube in front of the ruptured part.



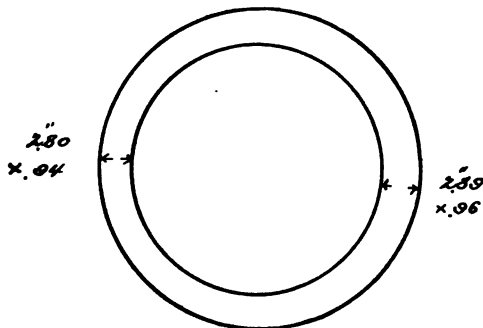
Taper of mandrel, ".04 per inch.

Two mandrels were forced through the ring, increasing the diameter of the bore from 12".22 to 12".92. Expansion, ".70 = 5.7 per cent.

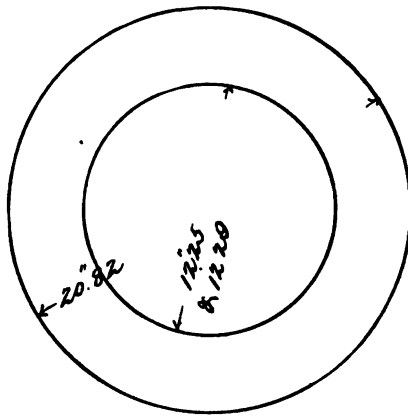
Third and fourth mandrels were forced through the ring, increasing the diameter of the bore to 13".93. Total expansion, (13".93 - 12".22) = 1".71 = 14.0 per cent.

Fifth and sixth mandrels were forced through the ring, increasing the diameter of the bore to 14".87. Total expansion, (14".87 - 12".22) = 2".65 = 21.7 per cent.

Final thickness of ring 2".80 and 2".89 on opposite sides as shown by the following sketch:



Section from tube, adjacent to hydrostatic test cylinder taken from breech portion, to the rear of the fractured part.



Length 1."

Taper of mandrel, ".04 per inch.

There were a number of cracks at the surface of the bore, visible upon boring out the rifling to the diameters above given. These cracks took a spiral direction, following the direction of the rifling.

The maximum pressure applied was reached with the third mandrel, amounting to 170,000 pounds.

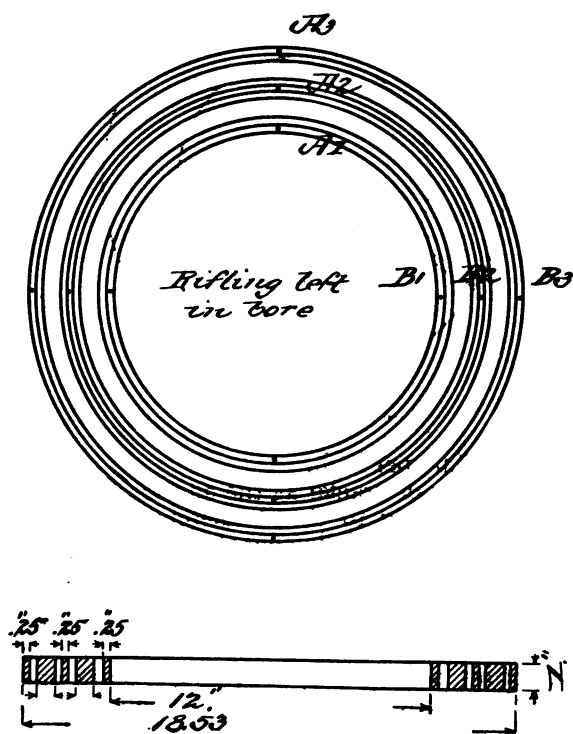
Ring ruptured with third mandrel, presenting a granular fracture beginning at the surface of the bore. There was also a crack started $1\frac{1}{4}$ " from the fracture, on one side, and a slight crack opened $2\frac{3}{8}$ " on the other side of the principal fracture; both secondary fractures were at the surface of the bore.

After rupture the circumference of the bore measured 41".55.

Circumferential extension at the bore, $41''.55 - 38''.48 = 3''.07 = 8.0$ per cent.

INITIAL STRAINS, TUBE OF 12-INCH RIFLE NO. 41.

Slice from muzzle portion of tube, in front of ruptured part.



INITIAL TENSION RINGS TAKEN FROM TUBE OF 12-INCH RIFLE NO.
41, MODEL OF 1888, M 1½.

Slice from muzzle portion of tube, in front of ruptured part.

SLICE INTACT.

Rings.	Diameters.		
	A.	B.	Mean.
	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>
1.....	12.4263	12.4210	12.4236 ⁵
2.....	15.3731	15.3626	15.3678 ⁵
3.....	18.2577	18.2550	18.2563 ⁵

ALL RINGS DETACHED.

1.....	12.4219	12.4160	12.4189 ⁵
2.....	15.3730	15.3622	15.3676
3.....	18.2597	18.2550	18.2573 ⁵

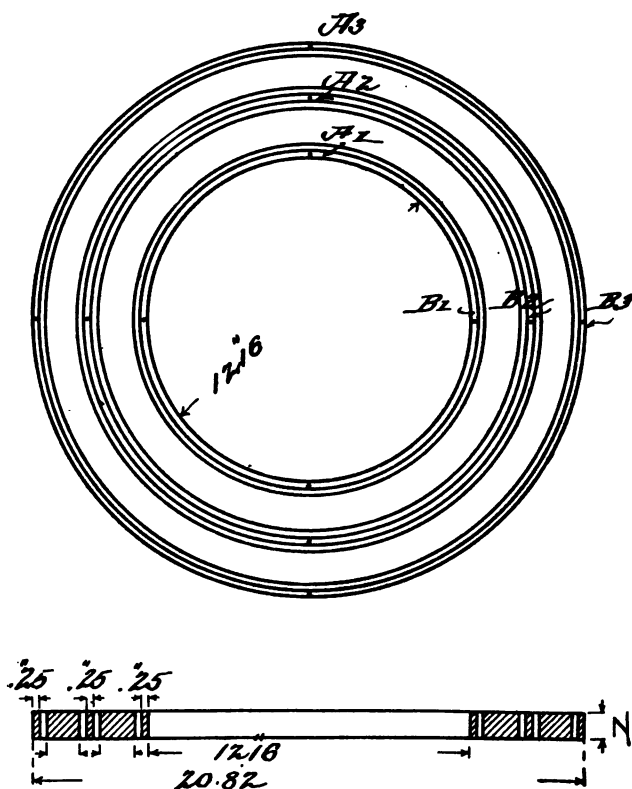
Mean diameters, original and final, and stresses corresponding to strains released.

Rings.	Mean diameters.		Strains released.	Corresponding stresses.	
	Original in the slice.	Final detached.		Tension, per square inch.	Compression, per square inch.
	<i>Inches.</i>	<i>Inches.</i>	<i>Inch.</i>	<i>Pounds.</i>	<i>Pounds.</i>
1.....	12.4236 ⁵	12.4189 ⁵	.0047	11,300	.....
2.....	15.3678 ⁵	15.3676	.0002 ⁵	600	.....
3.....	18.2563 ⁵	18.2573 ⁵	+.0010	.....	1,600

Initial tension ring No. 1 (next the bore) was cut apart radially. The ends of the ring sprung together when permitted to do so, overlapping a distance of 1½". This behavior showed the presence of internal strains of tension at the immediate surface of the bore.

TUBE OF 12-INCH RIFLE No. 41.

Slice from breech portion of tube to the rear of the fractured part.



Slice bored out to 12".16 diameter, removing the rifling and smoothing the bore. A number of longitudinal cracks were revealed at the bore.

Slice from breech portion of tube to the rear of the fractured part.

SLICE INTACT.

Rings.	Diameters.		
	A.	B.	Mean.
	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>
1.....	12. 4170	12. 4203	12. 4186 ^s
2.....	16. 5119	16. 5119	16. 5119
3.....	20. 5874	20. 6000	20. 5937

ALL RINGS DETACHED.

1.....	12. 4200	12. 4055	12. 4127 ^s
2.....	16. 5103	16. 5126	16. 5114 ^s
3.....	20. 5955	20. 5944	20. 5949 ^s

Slice from mandrel ring which was taken from tube adjacent to hydrostatic-test cylinder, in front of the ruptured part.

Initial strains determined after expansion of ring in mandrel test of 21.7 per cent., measured at the bore.

SLICE INTACT.

Rings.	Diameters.		
	A.	B.	Mean.
	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>
1.....	15.0867	15.0857	15.0862
2.....	17.7140	17.7084	17.7112
3.....	20.3261	20.3155	20.3208

ALL RINGS DETACHED.

1.....	15.1338	15.0649	15.0993 ^a
2.....	17.7128	17.7065	17.7111 ^a
3.....	20.8150	20.3132	20.5141

Mean diameters, original and final, and stresses corresponding to strains released.

Rings.	Mean diameters.		Strains released.	Corresponding stresses.	
	Original in the slice.	Final detached.		Tension, per square inch.	Compression, per square inch.
	<i>Inches.</i>	<i>Inches.</i>	<i>Inch.</i>	<i>Pounds.</i>	<i>Pounds.</i>
1.....	15.0862	15.0993 ^a	.0131 ^a	.....	26,100
2.....	17.7112	17.7111 ^a	.0000 ^a	80	.....
3.....	20.3208	20.3141	.0067	9,900	.....

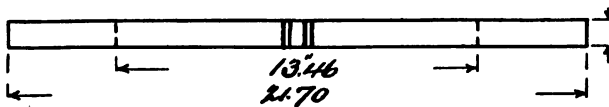
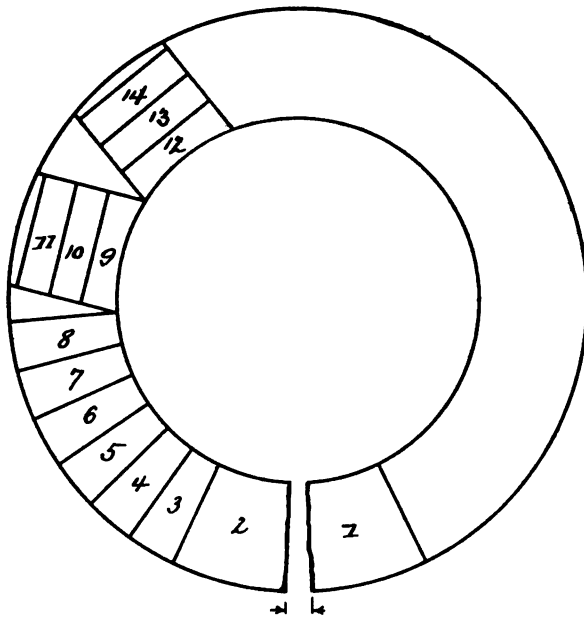
Ring No. 1 (next the bore) was sawed apart radially, whereupon the ends sprung apart a distance of ".95.

Ring No. 3 was also cut apart, the ends springing apart ".10.

Ring No. 2 sprung apart ".12, when cut radially.

TUBE OF 12-INCH RIFLE No. 41.

Tensile tests from ruptured mandrel ring.



No. 8522.

12" rifle, No. 41.

Marks, 3.

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Radial specimen from ruptured mandrel ring.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0003	0.	
10,000	.0006	.....	
30,000	.0019	.....	
35,000	.0023	.....	
40,000	.0027	0.	
41,000	.0028	.....	
42,000	.0029	.....	
43,000	.0035	.....	
44,000	.0035	.....	
45,000	.0037	.0005	
46,000	.0039	.....	
47,000	.0043	.....	
48,000	.0048	.....	
49,000	.0057	.....	
50,000	.0063	.0026	
51,000	.0072	.....	
52,000	.0080	.....	
53,000	.0087	.....	
54,000	.0104	.....	
55,000	.0114	.....	
56,000	.0127	.....	
57,000	.0141	.....	
58,000	.0150	.....	
59,000	.0167	.....	
60,000	.0194	.....	
62,000	.0245	.....	
64,000	.0294	.....	
66,000	.0315	.....	
68,000	.0430	.....	
70,000	.0485	.....	
75,000	.09	.....	
77,000			Tensile strength. =19.5 per cent elongation in 2".
0	.39	.....	

Elongation of inch sections, ".31*, ".08.

Diameter at fracture, ".37; area, .1075 square inch.

Contraction of area, 46.2 per cent.

Fractured ".80 from the neck.

Appearance of fracture, silky.

No. 8523.

12" rifle, No. 41.

Marks, 4.

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Radial specimen from ruptured mandrel ring.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0003	0.	
10,000	.0005		
30,000	.0020		
40,000	.0029	.0001	
41,000	.0030		
42,000	.0030		
43,000	.0031		
44,000	.0033		
45,000	.0035	.0005	
46,000	.0038		
47,000	.0041		
48,000	.0045		
49,000	.0051		
50,000	.0057	.0023	
51,000	.0066		
52,000	.0073		
53,000	.0084		
54,000	.0090		
55,000	.0105		
56,000	.0114		
57,000	.0128		
58,000	.0147		
59,000	.0160		
60,000	.0180		
62,000	.0220		
64,000	.0262		
66,000	.0292		
68,000	.0355		
70,000	.0435		
75,000	.08		
77,500			
0	.39		Tensile strength. = 19.5 per cent elongation in 2".

Elongation of inch sections, ".28*, ".11.

Diameter at fracture, ".40; area, .1257 square inch.

Contraction of area, 37.1 per cent.

Fractured 1" from the neck.

Appearance of fracture, silky.

No. 8524.

12" rifle, No. 41.

Marks, 5.

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Radial specimen from ruptured mandrel ring.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0003	0.	
10,000	.0005		
30,000	.0018		
40,000	.0024	0.	
41,000	.0025		
42,000	.0028		
43,000	.0032		
44,000	.0034		
45,000	.0035	.0004	
46,000	.0039		
47,000	.0039		
48,000	.0042		
49,000	.0044		
50,000	.0051	.0017	
51,000	.0058		
52,000	.0068		
53,000	.0078		
54,000	.0088		
55,000	.0095		
56,000	.0108		
57,000	.0128		
58,000	.0141		
59,000	.0157		
60,000	.0174		
62,000	.0220		
64,000	.0245		
66,000	.0308		
68,000	.0380		
70,000	.0446		
75,000	.08		
77,500			Tensile strength. =20 per cent elongation in 2".
0	.40		

Elongation of inch sections, ".24*, ".16.

Diameter at fracture, ".38; area, .1134 square inch.

Contraction of area, 43.3 per cent.

Fractured at middle of stem.

Appearance of fracture, silky.

No. 8525.

12" rifle, No. 41.

Marks, 9.

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Tangential specimen from ruptured mandrel ring.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0003	0.	
10,000	.0005	0.	
30,000	.0020	0.	
40,000	.0027	0.	
45,000	.0033	0.	
50,000	.0038	0.	
55,000	.0042	0.	
60,000	.0047	0.	
65,000	.0053	0.	
66,000	.0054	0.	
67,000	.0056	0.	
68,000	.0058	0.	
69,000	.0063	0.	
70,000	.0066	0.	
71,000	.0070	0.	
72,000	.0075	0.	
73,000	.0083	0.	
74,000	.0104	0.	
75,000	.0145	0.	
77,000	.0290	0.	
78,000	.0515	0.	
79,000	.0680	0.	
80,000	.0850	0.	
82,000	-----	-----	Tensile strength. —20.5 per cent elongation in 2".
0	.41	-----	

Elongation of inch sections, ".31*, ".10.

Diameter at fracture, ".40; area, .1257 square inch.

Contraction of area, 37.1 per cent.

Fractured ".60 from the neck.

Appearance of fracture, silky.

No. 8526.

12" rifle, No. 41.

Marks, 10.

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Tangential specimen from ruptured mandrel ring.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0005	.....	
30,000	.0018	.....	
40,000	.0027	0.	
45,000	.0032	0.	
50,000	.0038	0.	
55,000	.0043	.....	
56,000	.0045	.....	
57,000	.0043	.....	
58,000	.0049	.....	
59,000	.0054	.....	
60,000	.0055	.....	
61,000	.0058	.....	
62,000	.0060	.....	
63,000	.0063	.....	
64,000	.0070	.....	
65,000	.0084	.....	
66,000	.0100	.....	
67,000	.0180	.....	
68,000	.0220	.....	
69,000	.0270	.....	
70,000	.0380	.....	
71,000	.0470	.....	
72,000	.0570	.....	
73,000	.0720	.....	
74,000	.0940	.....	
75,000	.1080	.....	
78,000			Tensile strength. = 28 per cent elongation in 2".
0	.56	.....	

Elongation of inch sections, ".28*", ".28*.

Diameter at fracture, ".36; area, .1018 square inch.

Contraction of area, 49.1 per cent.

Fractured at middle of stem.

Appearance of fracture, silky.

STEEL FOR COMPARISON OF TESTING MACHINES.

TENSILE TESTS OF THREE STEEL BARS FOR COMPARISON OF TESTING MACHINE AT WORKS OF AMERICAN AND BRITISH MANUFACTURING COMPANY, BRIDGEPORT, CONN.

No. 8449.

Cold rolled steel.

Marks, No. 1. C. R.

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0002	0.	
10,000	.0005	.....	
30,000	.0018	.....	
35,000	.0022	.....	
40,000	.0025	.....	
45,000	.0028	.....	
50,000	.0031	0.	
55,000	.0035	.....	
60,000	.0038	.....	
65,000	.0042	.....	
70,000	.0046	.....	
75,000	.0050	.....	
80,000	.0059	.....	
81,000	.0062		Elastic limit (not well defined).
82,000	.0064	.....	
83,000	.0068	.....	
84,000	.0071	.....	
85,000	.0075	.....	
86,000	.0085	.....	
87,000	.0104	.....	
88,000	.0145	.....	
89,000	.0261	.....	
90,000	.0532	.....	
90,500			Tensile strength. = 15.5 per cent elongation in 2".
0	.31	.....	

Elongation of inch sections, ".25*, ".06.

Diameter at fracture, ".37; area, .1075 square inch.

Contraction of area, 46.2 per cent.

Fractured ".75 from the neck.

Appearance of fracture, silky.

No. 8450.

Machinery steel.

Marks, No. 2. Mach.

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0002	0.	
10,000	.0005	.....	
20,000	.0013	.....	
30,000	.0019		Elastic limit. Load fell.
35,000	.0025	.....	
37,000	.....	.....	
35,000	.0486		Tensile strength. = 39.0 per cent elongation in 2".
36,000	.0555	.....	
55,500	.....	.....	
0	.78	.....	

Elongation of inch sections, ".27, ".51*.

Diameter at fracture, ".28; area, .0616 square inch.

Contraction of area, 69.2 per cent.

Fractured 1".00 from the neck.

Appearance of fracture, fine silky.

H. Doc. 1322, 60-2—3

No. 8451.

Machinery steel.

Marks, No. 3. C.

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0007	.....	
20,000	.0014	.....	
30,000	.0022	0.	
35,000	.0025		Elastic limit. Load fell.
40,000	.0028	.....	
45,000	.0032	.....	
50,000	.0036	.....	
46,000	.0589	.....	
47,000	.0614		Tensile strength. = 34.0 per cent elongation in 2".
68,000	.....	.....	
0	.68	.....	

Elongation of inch sections, ".27, ".41*.

Diameter at fracture, ".32; area, .0804 square inch.

Contraction of area, 59.8 per cent.

Fractured 1".10 from the neck.

Appearance of fracture, fine silky.

TENSILE TESTS OF SIX STEEL BARS FOR COMPARISON OF TESTING MACHINE AT WORKS OF CRUCIBLE STEEL COMPANY OF AMERICA, PITTSBURG, PA.

No. 8473.

Marks, 1.

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0009	-----	
20,000	.0020	-----	
30,000	.0029	-----	
35,000	.0034	-----	
40,000	.0039	0.	Elastic limit.
43,000	.0043	-----	
44,000	.0044	-----	
45,000	.0045	-----	
46,000	.0350	-----	
47,000	.1100	-----	
48,000	.1109	-----	
49,000	.1112	-----	
50,000	.1117	-----	
51,000	.1145	-----	
51,000	.1205	-----	Tensile strength. =32.7 per cent elongation in 3".
66,500	-----	-----	
0	.98	-----	

Elongation of inch sections, ".21, ".54*, ".23.

Diameter at fracture, ".31; area, .0755 square inch.

Contraction of area, 62.2 per cent.

Fractured at middle of stem.

Appearance of fracture, fine silky.

No. 8474.

Marks, 3.

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	.....	
20,000	.0019	.....	
30,000	.0029	.....	
35,000	.0034	.....	
40,000	.0037	0.	
45,000	.0044	.....	
48,000	.0047	.....	
49,000	.0048	.....	Elastic limit.
55,000	.1545	.....	
66,500	.....	.....	Tensile strength.
0	.92	.....	=30.7 per cent elongation in 3".

Elongation of inch sections, ".19, ".47*, ".26.

Diameter at fracture, ".31; area, .0755 square inch.

Contraction of area, 62.2 per cent.

Fractured 1 ".45 from the neck.

Appearance of fracture, fine silky.

No. 8475.

Marks, 5.

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0009	.....	
20,000	.0020	.....	
30,000	.0030	.....	
35,000	.0035		Elastic limit.
40,000	.0040	0.	
43,000	.0045	.....	
44,000	.0045	.....	
45,000	.0046	.....	
46,000	.0060	.....	
47,000	.0650	.....	
48,000	.1070	.....	
49,000	.1150	.....	
50,000	.1170	.....	
51,000	.1205		Tensile strength.
66,500	.....	.....	
0	.97		- 32.3 per cent elongation in 3".

Elongation of inch sections, ".20, ".52*, ".25.

Diameter at fracture, ".30; area, .0707 square inch.

Contraction of area, 64.6 per cent.

Fractured 1".70 from the neck.

Appearance of fracture, fine silky.

No. 8476.

Marks, 7.

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	.....	
20,000	.0019	.....	
30,000	.0029	.....	
35,000	.0035		Elastic limit.
40,000	.0041	.0001	
41,000	.0105	.....	
42,000	.0210	.....	
43,000	.0245	.....	
44,000	.0500		Tensile strength. — 32.3 per cent elongation in 3".
45,000	.0750	.....	
46,000	.0940	.....	
66,500	.....	.....	
0	.97		

Elongation of inch sections, ".21, ".54*, ".22.

Diameter at fracture, ".31; area, .0755 square inch.

Contraction of area, 62.2 per cent.

Fractured 1".90 from the neck.

Appearance of fracture, fine silky.

No. 8477.

Marks, 9.

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0003	.....	
20,000	.0018	.....	
30,000	.0028	.....	
35,000	.0034		Elastic limit.
40,000	.0039	0.	
43,000	.0043	.....	
44,000	.0044	.....	
45,000	.0052	.....	
46,000	.0650		Tensile strength.
47,000	.0995	.....	
48,000	.1030	.....	
49,000	.1095	.....	
50,000	.1150	.....	
66,000			-31.7 per cent elongation in 3".
0	.95	.....	

Elongation of inch sections, " 20, " 53*, " 22.

Diameter at fracture, " 31; area, .0755 square inch.

Contraction of area, 62.2 per cent.

Fractured at middle of stem.

Appearance of fracture, fine silky.

No. 8478.

Marks, 11.

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008		
20,000	.0018	.....	
30,000	.0028	.....	
35,000	.0033		Elastic limit.
40,000	.0038	0.	
41,000	.0040	.....	
42,000	.0043	.....	
43,000	.0190	.....	
44,000	.0660	.....	
45,000	.0845	.....	
46,000	.0902	.....	
47,000	.0985	.....	
48,000	.1035	.....	
66,000			Tensile strength. -33.7 per cent elongation in 3".
0	1.01	.....	

Elongation of inch sections, ".23, ".55*, ".23.

Diameter at fracture, ".31; area, .0755 square inch.

Contraction of area, 62.2 per cent.

Fracture at middle of stem.

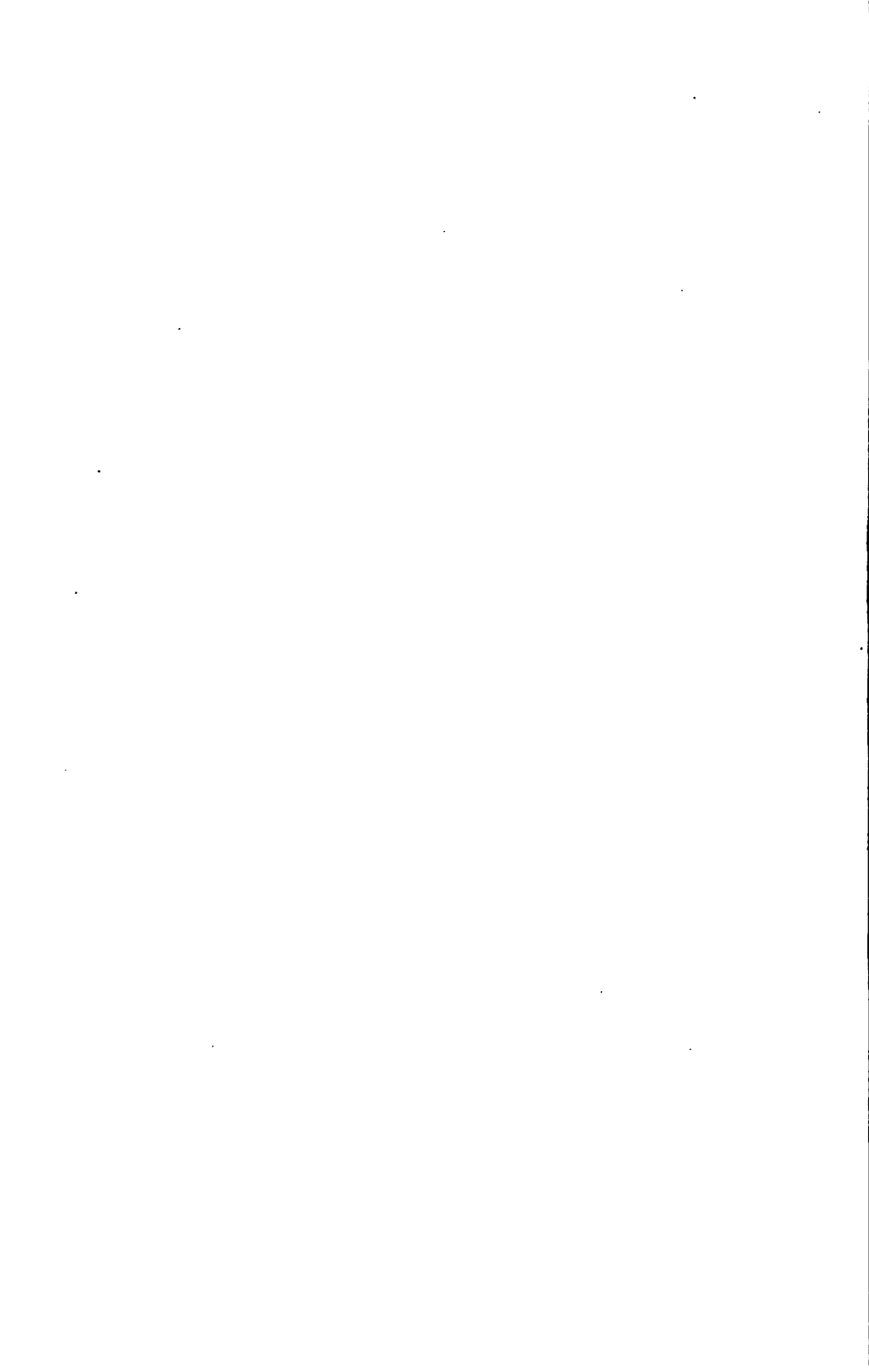
Appearance of fracture, fine silky.

TABULATION OF TENSION SPECIMENS FOR COMPARISON OF TESTING MACHINES.

Stems of specimens, .505" diameter; 2" and 3" long.

No. of test.	Marks.	For comparing testing machine at—	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
8449	No. 1 CR.	American and British Manufacturing Company, Bridgeport, Conn.	Pounds. 82,000	Pounds. 93,500	Per cent. 15.5	Per cent. 46.2	" .25*	" .06
8450	No. 2 Mh.	do.	37,000	55,500	30.0	69.2	.27	.51*
8451	No. 3 C.	do.	50,000	68,000	34.0	59.8	.27	.41*
8473	1.	Crucible Steel Company of America, Pittsburg, Pa.	45,000	66,500	32.7	62.2	.21	.54*
8474	3.	do.	49,000	66,500	30.7	62.2	.19	.47*
8475	5.	do.	45,000	66,500	32.3	64.6	.20	.52*
8476	7.	do.	40,000	66,500	32.3	62.2	.21	.54*
8477	9.	do.	44,000	66,000	34.7	62.2	.20	.53*
8478	11.	do.	42,000	66,000	33.7	62.2	.23	.55*

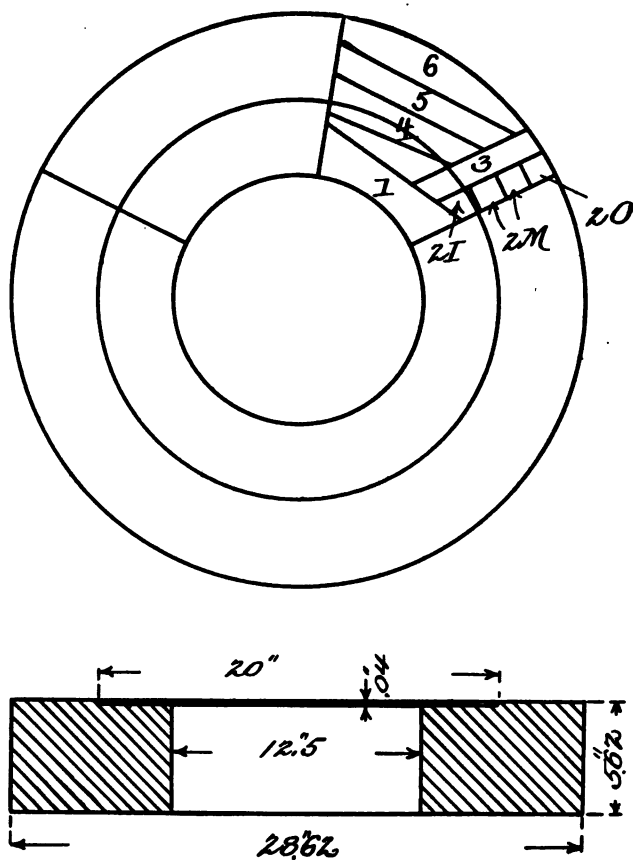
* Indicates fractured section.



STEEL WIRE.

INGOT METAL.

PUNCHED INGOT, TENSILE TESTS.



PUNCHED INGOT, 108181 C.

No. 8502.

Punched ingot, 108181 C.

Marks, 2 I. L.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	-----	
20,000	.0019	-----	
30,000	.0030	0.	
35,000	.0038	-----	
40,000	.0044	0.0002	
41,000	.0045	-----	
42,000	.0048	-----	
43,000	.0050	-----	
44,000	.0052	-----	Elastic limit.
45,000	.0056	.0008	
46,000	.0065	-----	
47,000	.0067	-----	
48,000	.0078	-----	
49,000	.0090	-----	
50,000	.0108	-----	
52,000	.0136	-----	
54,000	.0158	-----	
56,000	.0200	-----	
58,000	.0232	-----	
60,000	.0270	-----	
61,000	.0290	-----	
62,000	.0305	-----	
64,000	.0350	-----	
66,000	.0383	-----	Tensile strength. — 5.0 per cent elongation in 3".
68,000	.0415	-----	
70,000	.0483	-----	
75,000	.07	-----	
80,000	.08	-----	
85,000	.10	-----	
90,000	.12	-----	
94,800	-----	-----	
0	.15	-----	

Elongation of inch sections, ".07*, ".04, ".04.

Diameter at fracture, ".55; area, .2376 square inch.

Contraction of area, 5.0 per cent.

Fractured, ".95 from the neck.

Appearance of fracture, granular.

No. 8503.

Punched ingot, 108181 C.

Marks, 2 M. L.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008		
30,000	.0029	0.	
35,000	.0034		
40,000	.0040	0.	
45,000	.0045	0.	
47,000	.0049		
48,000	.0051		
49,000	.0052		
50,000	.0054	.0008	Elastic limit.
51,000	.0067		
52,000	.0070		
53,000	.0082		
54,000	.0096		
55,000	.0120		
56,000	.0137		
57,000	.0154		
58,000	.0163		
59,000	.0175		
60,000	.0210		
62,000	.0235		
64,000	.0275		
66,000	.0315		
68,000	.0350		
70,000	.0405		Tensile strength. —6.3 per cent elongation in 3".
75,000	.06		
80,000	.07		
85,000	.08		
90,000	.11		
95,000	.13		
100,000	.18		
100,400			
0	.19		

Elongation of inch sections, ".05, ".09*, ".05.

Diameter at fracture, ".55; area, .2376 square inch.

Contraction of area, 5.0 per cent.

Fractured 1".15 from the neck.

Appearance of fracture, granular.

No. 8504.

Punched ingot, 108181 C.

Marks, 2 M. L.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	0.	
30,000	.0029	0.	
35,000	.0035	0.	
40,000	.0042	0.	
43,000	.0045	0.	
44,000	.0052	0.	
45,000	.0053	.0006	
46,000	.0058	0.	
47,000	.0060	0.	Elastic limit.
48,000	.0067	0.	
49,000	.0073	0.	
50,000	.0097	0.	
52,000	.0123	0.	
54,000	.0152	0.	
56,000	.0180	0.	
58,000	.0210	0.	
60,000	.0235	0.	
64,000	.0325	0.	
68,000	.0405	0.	Tensile strength. =5.7 per cent elongation in 3".
70,000	.0440	0.	
75,000	.06	0.	
80,000	.08	0.	
85,000	.09	0.	
90,000	.11	0.	
95,000	.14	0.	
99,200	.17	0.	
0	.17	0.	

Elongation of inch sections, ".05, ".07*, ".05.

Diameter at fracture, ".55; area, .2376 square inch.

Contraction of area, 5.0 per cent.

Fractured 1".30 from the neck.

Appearance of fracture, granular.

No. 8505.

Punched ingot, 108181 C.

Marks, 2 O. L.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	-----	
30,000	.0027	0.	
35,000	.0033	-----	
40,000	.0039	0.	
45,000	.0045	.0002	
46,000	.0048	-----	
47,000	.0049	-----	
48,000	.0052	-----	
49,000	.0055	-----	Elastic limit.
50,000	.0058	.0009	
51,000	.0063	-----	
52,000	.0075	-----	
53,000	.0090	-----	
54,000	.0106	-----	
55,000	.0125	-----	
56,000	.0138	-----	
57,000	.0158	-----	
58,000	.168	-----	
59,000	.0180	-----	Tensile strength. — 3.0 per cent elongation in 3".
60,000	.0194	-----	
62,000	.0235	-----	
64,000	.0270	-----	
66,000	.0330	-----	
68,000	.0353	-----	
70,000	.0390	-----	
75,000	.05	-----	
80,000	.07	-----	
85,000	.08	-----	
90,000	.10	-----	
95,000	.12	-----	
100,000	.15	-----	
105,600	-----	-----	
0	.24	-----	

Elongation of inch sections, ".06, ".08, ".10*.

Diameter at fracture, ".54; area, .2290 square inch.

Contraction of area, 8.4 per cent.

Fractured 1".00 from the neck.

Appearance of fracture, granular.

No. 8506.

Punched ingot, 108181 C.

Marks, 3 R.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0006	0.	
20,000	.0028	0.	
35,000	.0035	0.	
40,000	.0040	.0001	
41,000	.0044	0.	
43,000	.0046	0.	
44,000	.0049	0.	
45,000	.0050	.0005	
46,000	.0056	0.	Elastic limit.
47,000	.0063	0.	
48,000	.0067	0.	
49,000	.0072	0.	
50,000	.0080	.0030	
51,000	.0093	0.	
52,000	.0130	0.	
54,000	.0138	0.	
56,000	.0166	0.	
58,000	.0202	0.	
60,000	.0235	0.	
62,000	.0260	0.	
64,000	.0330	0.	
66,000	.0370	0.	
68,000	.0395	0.	
70,000	.0425	0.	
75,000	.06	0.	
80,000	.07	0.	
85,000	.09	0.	
90,000	.11	0.	
95,000	.13	0.	
100,000	.16	0.	
107,600	0.	0.	Tensile strength. =12.0 per cent elongation in 3".
0	.26	0.	

Elongation of inch sections, ".10, ".16*, ".10.

Diameter at fracture, ".52; area, .2124 square inch.

Contraction of area, 15.0 per cent.

Fractured 1".45 from the neck.

Appearance of fracture, granular.

No. 8507.

Punched ingot, 108181 C.

Marks, 3 R.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0007	0.	
20,000	.0026	0.	
35,000	.0033	0.	
40,000	.0039	0.	
44,000	.0043	0.	
45,000	.0044	.0002	
46,000	.0047	0.	
47,000	.0048	0.	
48,000	.0052	0.	Elastic limit.
49,000	.0053	0.	
50,000	.0058	.0008	
51,000	.0063	0.	
52,000	.0070	0.	
53,000	.0087	0.	
54,000	.0099	0.	
55,000	.0120	0.	
56,000	.0135	0.	
58,000	.0173	0.	
60,000	.0210	0.	Tensile strength. —8.7 per cent elongation in 3".
62,000	.0245	0.	
64,000	.0280	0.	
66,000	.0325	0.	
68,000	.0370	0.	
70,000	.0409	0.	
75,000	.06	0.	
80,000	.07	0.	
85,000	.08	0.	
90,000	.10	0.	
95,000	.12	0.	
100,000	.15	0.	
107,600	.26	0.	
0	.26	0.	

Elongation of inch sections, ".07, ".09, ".10*.

Diameter at fracture, ".53; area, .2206 square inch.

Contraction of area, 11.8 per cent.

Fractured ".60 from the neck.

Appearance of fracture, granular.

No. 8508.

Punched ingot, 108181 C.

Marks, 3 R.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	0.	
30,000	.0027	0.	
35,000	.0033	0.	
40,000	.0040	0.	
42,000	.0043	0.	
44,000	.0047	0.	
45,000	.0048	.0004	
46,000	.0053	0.	
47,000	.0058	0.	Elastic limit.
48,000	.0065	0.	
49,000	.0074	0.	
50,000	.0082	.0029	
51,000	.0096	0.	
52,000	.0112	0.	
53,000	.0125	0.	
54,000	.0140	0.	
56,000	.0175	0.	
58,000	.0198	0.	
60,000	.0240	0.	
62,000	.0277	0.	
64,000	.0335	0.	
66,000	.0380	0.	
68,000	.0405	0.	
70,000	.0440	0.	
75,000	.06	0.	
80,000	.07	0.	
85,000	.09	0.	
90,000	.11	0.	
95,000	.13	0.	
100,000	.16	0.	
106,400	-----	-----	Tensile strength. — 10.7 per cent elongation in 3".
0	.32	-----	

Elongation of inch sections, ".07, ".11, ".14*.

Diameter at fracture, ".52; area, .2124 square inch.

Contraction of area, 15.0 per cent.

Fractured ".50 from the neck.

Appearance of fracture, granular, silky spot at circumference.

No. 8509.

Punched ingot, 108181 C.

Marks, 3 R.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0006	0.	
30,000	.0027	0.	
35,000	.0035		
40,000	.0042	.0002	
41,000	.0044		
42,000	.0046		
43,000	.0047		
44,000	.0048		
45,000	.0050	.0005	
46,000	.0055		
47,000	.0056		
48,000	.0060		
49,000	.0066		Elastic limit.
50,000	.0075	.0023	
51,000	.0088		
52,000	.0088		
53,000	.0115		
54,000	.0137		
56,000	.0165		
58,000	.0200		
60,000	.0236		
62,000	.0270		
64,000	.0325		
66,000	.0355		
68,000	.0390		
70,000	.0435		
75,000	.06		
80,000	.07		
85,000	.08		
90,000	.10		
95,000	.13		
100,000	.16		
107,800			Tensile strength. —12.3 per cent elongation in 3".
0	.37		

Elongation of inch sections, ".17*, ".12, ".08.

Diameter at fracture, ".51; area, .2043 square inch.

Contraction of area, 18.3 per cent.

Fractured ".67 from the neck.

Appearance of fracture, fine granular, silky center.

No: 8510.

Punched ingot, 108181 C.

Marks, 4 T.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	0.	
30,000	.0029	0.	
35,000	.0035	0.	
40,000	.0041	.0001	
41,000	.0043	0.	
43,000	.0045	0.	
45,000	.0046	.0002	
46,000	.0050	0.	
47,000	.0052	0.	Elastic limit.
48,000	.0054	0.	
49,000	.0056	0.	
50,000	.0059	.0009	
51,000	.0070	0.	
52,000	.0087	0.	
53,000	.0112	0.	
54,000	.0120	0.	
55,000	.0139	0.	
56,000	.0154	0.	
58,000	.0190	0.	Tensile strength.
60,000	.0230	0.	
62,000	.0270	0.	
64,000	.0305	0.	
66,000	.0346	0.	
68,000	.0395	0.	
70,000	.0422	0.	
75,000	.05	0.	
80,000	.07	0.	
85,000	.08	0.	
90,000	.10	0.	-13.3 per cent elongation in 3".
95,000	.12	0.	
100,000	.16	0.	
108,000	0.	0.	
0	.40	0.	

Elongation of inch sections, ".11, ".18*, ".11.

Diameter at fracture, ".52; area, .2124 square inch.

Contraction of area, 15.0 per cent.

Fractured 1".38 from the neck.

Appearance of fracture, fine granular.

No. 8511.

Punched ingot, 108181 C.

Marks, 4 T.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0007	0.	
30,000	.0029	0.	
35,000	.0034	0.	
40,000	.0040	0.	
41,000	.0043	0.	
43,000	.0045	0.	
45,000	.0048	.0004	
46,000	.0055	0.	
47,000	.0058	0.	Elastic limit.
48,000	.0063	0.	
49,000	.0070	0.	
50,000	.0080	.0030	
51,000	.0100	0.	
52,000	.0110	0.	
53,000	.0125	0.	
54,000	.0142	0.	
56,000	.0175	0.	
58,000	.0208	0.	
60,000	.0247	0.	Tensile strength. = 13.7 per cent elongation in 3".
62,000	.0290	0.	
64,000	.0340	0.	
66,000	.0375	0.	
68,000	.0400	0.	
70,000	.0450	0.	
75,000	.05	0.	
80,000	.07	0.	
85,000	.09	0.	
90,000	.10	0.	
95,000	.13	0.	
100,000	.16	0.	
107,600	0.	0.	
0	.41	0.	

Elongation of inch sections, ".10, ".20 *, ".11.

Diameter at fracture, ".51; area, .2043 square inch.

Contraction of area, 18.3 per cent.

Fractured 1".45 from the neck.

Appearance of fracture, fine granular, silky center.

No. 8512.

Punched ingot, 108181 C.

Marks, 4 T.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	0.	
30,000	.0029	0.	
35,000	.0034	0.	
40,000	.0042	.0002	
41,000	.0044		
42,000	.0045		
43,000	.0046		
44,000	.0050		
45,000	.0054	.0008	Elastic limit.
46,000	.0064		
47,000	.0074		
48,000	.0086		
49,000	.0108		
50,000	.0119	.0068	
51,000	.0135		
52,000	.0144		
54,000	.0178		
56,000	.0215		
58,000	.0270		
60,000	.0293		
62,000	.0335		
64,000	.0380		
66,000	.0414		
68,000	.0460		
70,000	.0510		
75,000	.07		
80,000	.08		
85,000	.09		
90,000	.12		
95,000	.14		
100,000	.18		
105,200			
0	.40		Tensile strength. =13.3 per cent elongation in 3".

Elongation of inch sections, ".16*, ".14, " 10.

Diameter at fracture, ".51; area, .2043 square inch.

Contraction of area, 18.3 per cent.

Fractured 1" from the neck.

Appearance of fracture, fine granular, silky spot at circumference.

No. 8513.

Punched ingot, 108181 C.

Marks, 4 T.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	.....	
30,000	.0030	0.	
35,000	.0036	.....	
40,000	.0043	.0002	
41,000	.0044	.....	
42,000	.0045	.....	
43,000	.0048	.....	
44,000	.0050	.....	
45,000	.0050	.0006	Elastic limit.
46,000	.0055	.....	
47,000	.0059	.....	
48,000	.0062	.....	
49,000	.0070	.....	
50,000	.0084	.0035	
51,000	.0099	.....	
52,000	.0108	.....	
54,000	.0145	.....	
56,000	.0175	.....	
58,000	.0240		Tensile strength. = 14.0 per cent elongation in 3".
60,000	.0253	.....	
62,000	.0293	.....	
64,000	.0330	.....	
66,000	.0368	.....	
68,000	.0403	.....	
70,000	.0445	.....	
75,000	.06	.....	
80,000	.07	.....	
85,000	.09	.....	
90,000	.11	.....	
95,000	.13	.....	
100,000	.16	.....	
107,600	.....	.....	
0	.42	.....	

Elongation of inch sections, ".10, .19*, ".13.

Diameter at fracture, ".51; area .2043 square inch.

Contraction of area, 18.3 per cent.

Fractured 1".45 from the neck.

Appearance of fracture, fine granular, silky spot at circumference.

No. 8514.

Punched ingot, 108181 C.

Marks, 5 T.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0006	0.	
30,000	.0030	0.	
35,000	.0035	0.	
40,000	.0043	0.	
41,000	.0043	0.	
42,000	.0044	0.	
43,000	.0047	0.	
44,000	.0048	0.	
45,000	.0050	.0003	Elastic limit.
46,000	.0053	0.	
47,000	.0055	0.	
48,000	.0060	0.	
49,000	.0064	0.	
50,000	.0073	.0023	
51,000	.0085	0.	
52,000	.0113	0.	
54,000	.0150	0.	
56,000	.0177	0.	
58,000	.0215	0.	Tensile strength. = 16.0 per cent elongation in 3".
60,000	.0248	0.	
62,000	.0285	0.	
64,000	.0345	0.	
66,000	.0375	0.	
68,000	.0430	0.	
70,000	.0458	0.	
75,000	.06	0.	
80,000	.07	0.	
85,000	.09	0.	
90,000	.10	0.	
95,000	.11	0.	
100,000	.15	0.	
107,800	.48	0.	
0	.48	0.	

Elongation of inch sections, ".11, ".25*, ".12.

Diameter at fracture, ".50; area, .1964 square inch.

Contraction of area, 21.4 per cent.

Fractured 1".65 from the neck.

Appearance of fracture, fine granular 80 per cent, silky 20 per cent

No. 8515.

Punched ingot, 108181 C.

Marks, 5 T.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	0.	
30,000	.0030	0.	
35,000	.0035	0.	
40,000	.0042	.0001	
41,000	.0043	0.	
42,000	.0045	0.	
43,000	.0045	0.	
44,000	.0047	0.	
45,000	.0048	.0002	Elastic limit.
46,000	.0050	0.	
47,000	.0052	0.	
48,000	.0055	0.	
49,000	.0055	0.	
50,000	.0058	.0006	
51,000	.0064	0.	
52,000	.0069	0.	
53,000	.0080	0.	
54,000	.0104	0.	
55,000	.0120	0.	Tensile strength.
56,000	.0137	0.	
58,000	.0166	0.	
60,000	.0200	0.	
62,000	.0245	0.	
64,000	.0273	0.	
66,000	.0320	0.	
68,000	.0363	0.	
70,000	.0395	0.	
75,000	.05	0.	
80,000	.06	0.	-14.7 per cent elongation in 3".
85,000	.08	0.	
90,000	.09	0.	
95,000	.11	0.	
100,000	.13	0.	
108,200	.44	0.	
0	.44	0.	

Elongation of inch sections ".11, ".21*, ".12.

Diameter at fracture, ".50; area, .1964 square inch.

Contraction of area, 21.4 per cent.

Fractured 1".70 from the neck.

Appearance of fracture, fine granular 90 per cent, silky 10 per cent.

No. 8516.

Punched ingot, 108181 C.

Marks, 5 T.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	0.	
30,000	.0029	0.	
35,000	.0035	0.	
40,000	.0041	0.	
41,000	.0045	0.	
42,000	.0046	0.	
43,000	.0047	0.	
44,000	.0049	0.	
45,000	.0050	.0003	Elastic limit.
46,000	.0053	0.	
47,000	.0055	0.	
48,000	.0059	0.	
49,000	.0065	0.	
50,000	.0076	.0025	
51,000	.0080	0.	
52,000	.0109	0.	
54,000	.0128	0.	
56,000	.0160	0.	
58,000	.0191	0.	
60,000	.0230	0.	
62,000	.0275	0.	
64,000	.0335	0.	
66,000	.0357	0.	
68,000	.0385	0.	Tensile strength.
70,000	.0445	0.	
75,000	.05	0.	
80,000	.07	0.	
85,000	.08	0.	
90,000	.10	0.	= 13.7 per cent elongation in 3".
95,000	.11	0.	
100,000	.15	0.	
108,000	.41	0.	
0			

Elongation of inch sections, ".12, ".19*, ".10.

Diameter at fracture, ".51; area, .2043 square inch.

Contraction of area, 18.3 per cent.

Fractured 1".45 from the neck.

Appearance of fracture, fine granular.

No. 8517.

Punched ingot, 108181 C.

Marks, 5 T.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0003	0.	
10,000	.0009	0.	
30,000	.0030	0.	
35,000	.0037	0.	
40,000	.0043	0.	
41,000	.0043		
42,000	.0045		
43,000	.0047		
44,000	.0049		
45,000	.0050	.0003	
46,000	.0053		
47,000	.0055		
48,000	.0060		
49,000	.0063		Elastic limit.
50,000	.0070	.0019	
51,000	.0084		
52,000	.0102		
54,000	.0128		
56,000	.0156		
58,000	.0192		
60,000	.0228		
62,000	.0265		
64,000	.0315		
66,000	.0353		
68,000	.0385		
70,000	.0426		
75,000	.05		
80,000	.07		
85,000	.08		
90,000	.10		
95,000	.11		
100,000	.15		Tensile strength.
108,400			=14.7 per cent elongation in 3".
0	.44		

Elongation of inch sections, ".11, ".21*, ".12.

Diameter at fracture, ".51; area, .2043 square inch.

Contraction of area, 18.3 per cent.

Fractured 1".60 from the neck.

Appearance of fracture, fine granular 85 per cent, silky 15 per cent.

No. 8518.

Punched ingot, 108181 C.

Marks, 6 T.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	0.	
30,000	.0029	0.	
35,000	.0034	0.	
40,000	.0040	0.	
41,000	.0042		
42,000	.0044		
43,000	.0044		
44,000	.0046		
45,000	.0047	.0001	Elastic limit.
46,000	.0049		
47,000	.0050		
48,000	.0053		
49,000	.0056		
50,000	.0060	.0008	
51,000	.0065		
52,000	.0070		
53,000	.0088		
54,000	.0096		
55,000	.0112		Tensile strength.
56,000	.0133		
58,000	.0153		
60,000	.0197		
62,000	.0230		
64,000	.0268		
66,000	.0306		
68,000	.0350		
70,000	.0380		
75,000	.05		
80,000	.06		=14.7 per cent elongation in 3".
85,000	.07		
90,000	.09		
95,000	.11		
100,000	.13		
110,400			
0	.44		

Elongation of inch sections, ".11, ".22*, ".11.

Diameter at fracture, ".50; area, .1964 square inch.

Contraction of area, 21.4 per cent.

Fractured 1".75 from the neck.

Appearance of fracture, fine granular, silky spot at circumference.

No. 8519.

Punched ingot, 108181 C.

Marks, 6 T.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	.44	0.	Initial load.
5,000	.0003	0.	
10,000	.0008	0.	
30,000	.0029	0.	
35,000	.0034	0.	
40,000	.0039	0.	
41,000	.0040	0.	
42,000	.0042	0.	
43,000	.0043	0.	
44,000	.0044	0.	
45,000	.0045	0.	Elastic limit.
46,000	.0046	0.	
47,000	.0048	0.	
48,000	.0051	0.	
49,000	.0053	0.	
50,000	.0057	.0006	
51,000	.0065	0.	
52,000	.0070	0.	
53,000	.0090	0.	
54,000	.0105	0.	
55,000	.0120	0.	Tensile strength.
56,000	.0134	0.	
58,000	.0160	0.	
60,000	.0198	0.	
62,000	.0233	0.	
64,000	.0270	0.	
66,000	.0318	0.	
68,000	.0350	0.	
70,000	.0395	0.	
75,000	.05	0.	
80,000	.06	0.	=15.3 per cent elongation in 3".
85,000	.08	0.	
90,000	.10	0.	
95,000	.11	0.	
100,000	.14	0.	
109,600			
0	.46		

Elongation of inch sections, ".13, ".23*, ".10.

Diameter at fracture, ".50; area, .1964 square inch.

Contraction of area, 21.4 per cent.

Fractured 1".55 from the neck.

Appearance of fracture, fine granular 70 per cent, silky 30 per cent.

No. 8520.

Punched ingot, 108181 C.
 Marks, 6 T.
 Diameter, ".564.
 Sectional area, .25 square inch.
 Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008		
30,000	.0029	0.	
35,000	.0034		
40,000	.0039	0.	
41,000	.0040		
42,000	.0041		
43,000	.0043		
44,000	.0044		
45,000	.0044		
46,000	.0048		
47,000	.0048		
48,000	.0050		
49,000	.0050		
50,000	.0053	.0002	
51,000	.0055		
52,000	.0062		
53,000	.0063		
54,000	.0064		Elastic limit.
55,000	.0083		
56,000	.0108		
58,000	.0140		
60,000	.0172		
62,000	.0202		
64,000	.0240		
66,000	.0280		
68,000	.0325		
70,000	.0360		
75,000	.05		Tensile strength. =15.3 per cent elongation in 3".
80,000	.06		
85,000	.07		
90,000	.09		
95,000	.10		
100,000	.13		
111,200	.46		
0			

Elongation of inch sections, ".18*, ".18*, ".10.
 Diameter at fracture, ".49; area, .1886 square inch.
 Contraction of area, 24.6 per cent.
 Fractured 1".25 from the neck.
 Appearance of fracture, fine granular 85 per cent, silky 15 per cent.

No. 8521.

Punched ingot, 108181 C.

Marks, 6 T.

Diameter, ".564.

Sectional area, .25 square inch.

Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0008		
30,000	.0028	0.	
35,000	.0033		
40,000	.0038	0.	
41,000	.0040		
42,000	.0040		
43,000	.0043		
44,000	.0043		
45,000	.0045	.0002	Elastic limit.
46,000	.0045		
47,000	.0048		
48,000	.0048		
49,000	.0050		
50,000	.0052	.0005	
51,000	.0056		
52,000	.0058		
53,000	.0065		
54,000	.0083		
55,000	.0104		
56,000	.0115		
58,000	.0144		
60,000	.0180		
62,000	.0212		
64,000	.0268		Tensile strength. =15.3 per cent elongation in 3".
66,000	.0290		
68,000	.0355		
70,000	.0375		
75,000	.05		
80,000	.06		
85,000	.07		
90,000	.09		
95,000	.11		
100,000	.14		
110,800			
0	.46		

Elongation of inch sections, ".10, ".22*, ".14.

Diameter at fracture, ".50; area, .1964 square inch.

Contraction of area, 21.4 per cent.

Fractured 1".40 from the neck.

Appearance of fracture, fine granular, silky center.

TENSILE SPECIMENS FROM PUNCHED INGOT MARKED 108181C.

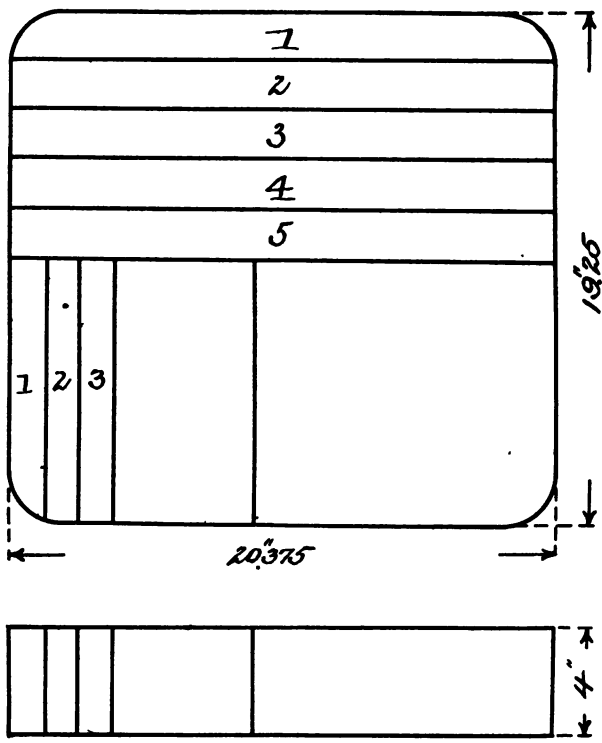
Specimens ".505 diameter. 3" lengths of stems.

No. of test.	Marks.	Direction.	Elastic limit.	Tensile strength.	Elongation.	Contraction.	Elongation of inch sections.	Appearance of fracture.
			Pounds.	Pounds.	Per cent.	Per cent.	" "	
8502	2-I	Longitudinal	47,000	100,400	5	5	.07*, .04, .04	Granular.
8503	2-M	do.	52,000	99,200	6.3	5	.05, .03*, .05	Do.
8504	2-M	do.	49,000	99,200	5.7	5	.05, .07*, .05	Do.
8505	2-O	do.	51,000	105,600	8	8.4	.06, .08, .10*	Do.
8506	3	Radial	49,000	107,600	12	15	.10, .16*, .10	Do.
8507	3	do.	52,000	107,600	8.7	11.8	.07, .09, .10*	Granular, silky spot at circumference.
8508	3	do.	48,000	106,400	10.7	15	.07, .11, .14*	Granular, silky center.
8509	3	do.	49,000	107,600	12.3	18.3	.17*, .12, .08	Granular, silky center.
8510	4	Tangential	50,000	108,000	13.3	15	.11, .19*, .11	Fine granular.
8511	4	do.	49,000	107,600	13.7	18.3	.10, .20*, .11	Fine granular, silky center.
8512	4	do.	45,000	105,200	13.3	18.3	.16*, .14, .10	Fine granular, silky spot at circumference.
8513	4	do.	48,000	107,600	14	18.3	.10, .19*, .13	Do.
8514	5	do.	49,000	107,600	16	21.4	.11, .25*, .12	Fine granular, 80 per cent; silky, 20 per cent.
8515	5	do.	52,000	109,200	14.7	21.4	.11, .21*, .12	Fine granular, 90 per cent; silky, 10 per cent.
8516	5	do.	49,000	108,000	13.7	18.3	.12, .19*, .10	Fine granular.
8517	5	do.	49,000	108,400	14.7	18.3	.11, .21*, .12	Fine granular, 85 per cent; silky, 15 per cent.
8518	6	do.	52,000	110,400	14.7	21.4	.11, .22*, .11	Fine granular, silky spot at circumference.
8519	6	do.	52,000	109,600	15.3	21.4	.13, .23*, .10	Fine granular, 70 per cent; silky, 30 per cent.
8520	6	do.	54,000	111,200	15.6	24.6	.18*, .19*, .10	Fine granular, 85 per cent; silky, 15 per cent.
8521	6	do.	53,000	110,800	15.3	21.4	.10, .22*, .14	Fine granular, silky center.



SECTION OF STEEL INGOT.

SECTION OF STEEL INGOT.



No. 8492.

Ingot, 19"×20".375×4".

Marks, 1.

Diameter, 1".129.

Sectional area, 1.00 square inch.

Gauged length, 10".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
1,000	0.	0.	
5,000	.0011	0.	
10,000	.0030	0.	
30,000	.0095	— .0002	
35,000	.0111	.....	
36,000	.0116	.....	
37,000	.0119	.....	
38,000	.0125	.....	
39,000	.0130	.....	
40,000	.0132	0.	
41,000	.0137	.....	
42,000	.....	.....	
0	.02	.....	
			Tensile strength. — .2 per cent elongation in 10".

Elongation of inch sections, ".00, ".00, ".00, ".01, ".01, ".01, ".01, ".01, ".01, ".02.

Diameter at fracture, 1".129; area, 1.00 square inch.

Contraction of area, 0.0 per cent.

Fractured, ".90 from the neck.

Appearance of fracture, columnar, with dark blue patch at circumference.

No. 8493.

Ingot, 19" × 20".375 × 4".

Marks, 2.

Diameter, 1".129.

Sectional area, 1.00 square inch.

Gauged length, 10".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0010	0.	
10,000	.0023		
30,000	.0091	0.	
35,000	.0112		
40,000	.0132	.0003	Elastic limit.
41,000	.0139		
42,000	.0145		
43,000	.0149		
44,000	.0158		
45,000	.0166	.0013	
46,000	.0172		
47,000	.0188		
48,000	.0214		
49,000	.0238		
50,000	.0280		
52,000	.05		
54,000	.06		
56,000	.07		
58,000	.09		
60,000	.10		
62,000	.11		
64,000	.12		
66,000	.14		
68,000	.15		
70,000	.16		
71,200			Tensile strength. = 1.6 per cent elongation in 10".
0	.16		

Elongation of inch sections, ".01, ".01, ".05*, ".02, ".01, ".00, ".02, ".01, ".01, ".02.

Diameter at fracture, 1".12; area, .9852 square inch.

Contraction of area, 1.5 per cent.

Fractured 2".85 from the neck.

Appearance of fracture, coarse granular, flaky.

No. 8494.

Ingot, 19"×20" .375×4".

Marks, 3.

Diameter, 1".129.

Sectional area, 1.00 square inch.

Gauged length, 10".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0011	0.	
10,000	.0030	0.	
30,000	.0101	0.	
35,000	.0130	0.	
36,000	.0132	0.	
37,000	.0138	0.	
38,000	.0140	0.	
39,000	.0145	0.	
40,000	.0150	.0011	
41,000	.0157	0.	Elastic limit.
42,000	.0165	0.	
43,000	.0180	0.	
44,000	.0200	0.	
45,000	.0225	0.	
46,000	.0260	0.	
47,000	.0310	0.	
48,000	.0350	0.	
49,000	.0405	0.	
50,000	.0450	0.	
52,000	.07	0.	Tensile strength. = 1.3 per cent elongation in 10".
54,000	.09	0.	
56,000	.10	0.	
58,000	.11	0.	
60,000	.12	0.	
62,000	.14	0.	
62,300	.....	.....	
0	.13	.....	

Elongation of inch sections, ".01, ".01, ".01, ".02, ".01, ".03*, ".01, ".01, ".01, ".01.

Diameter at fracture, 1".12; area, .9852 square inch.

Contraction of area, 1.5 per cent.

Fractured 5".23 from the neck.

Appearance of fracture, coarse granular, flaky.

No. 8495.

Ingot, 19"×20"×.375×4".

Marks, 4.

Diameter, 1".129.

Sectional area, 1.00 square inch.

Gauged length, 10".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0010	0.	
10,000	.0028	0.	
30,000	.0100	0.	
35,000	.0119	.....	
36,000	.0122	.....	
37,000	.0130	.....	
38,000	.0134	.....	
39,000	.0141	.....	
40,000	.0152	.0015	
41,000	.0160		Elastic limit.
42,000	.0175	.....	
43,000	.0198	.....	
44,000	.0225	.....	
45,000	.0270	.0110	
46,000	.0302	.....	
47,000	.0352	.....	
48,000	.0390	.....	
49,000	.0420	.....	
50,000	.0485	.....	
52,000	.08		Tensile strength. = 1.3 per cent elongation in 10".
54,000	.09	.....	
56,000	.10	.....	
58,000	.12	.....	
60,000	.13	.....	
62,000	.15	.....	
63,300	.....	.....	
0	.13	.....	

Elongation of inch sections, ".03*, ".01, ".01, ".02, ".01, ".01, ".01, ".01, ".02, ".00.

Diameter at fracture, 1".12; area, .9852 square inch.

Contraction of area, 1.5 per cent.

Fractured ".25 from the neck.

Appearance of fracture, coarse granular, flaky.

No. 8496.

Ingot, 19" × 20" .375 × 4".

Marks, 5.

Diameter, 1".129.

Sectional area, 1.00 square inch.

Gauged length, 10".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0011	0.	
10,000	.0020		
30,000	.0101	.0001	
35,000	.0118		
36,000	.0122		
37,000	.0130		
38,000	.0138		
39,000	.0147		
40,000	.0157	.0020	Elastic limit.
41,000	.0167		
42,000	.0184		
43,000	.0205		
44,000	.0235		
45,000	.0270	.0115	
46,000	.0310		
47,000	.0375		
48,000	.0425		
49,000	.0490		
50,000	.0560		Tensile strength. = 1.6 per cent elongation in 10".
52,000	.08		
54,000	.09		
56,000	.10		
58,000	.11		
60,000	.13		
62,000	.15		
64,000	.16		
64,800	-----	-----	
0	.16	-----	

Elongation of inch sections, ".01, ".01, ".01, ".03, ".01, ".01, ".01, ".01, ".01, ".05*.

Diameter at fracture, 1".12; area, .9852 square inch.

Contraction of area, 1.5 per cent.

Fractured ".30 from the neck.

Appearance of fracture, coarse granular, flaky.

No. 8497.

Ingot, 19" × 20".375 × 4".

Marks; 1, annealed.

Diameter, 1".129.

Sectional area, 1.00 square inch.

Gauged length, 10".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0011	0.	
10,000	.0026		
30,000	.0092	-.0002	
35,000	.0111		
40,000	.0130	-.0001	
45,000	.0147	-.0002	
50,000	.0167	0.	
53,000	.0180		
54,000	.0185		
55,000	.0195		Elastic limit.
56,000	.0740		
57,000	.0796		
58,000	.0832		
59,000	.0890		
60,000	.0950		
64,000	.13		
68,000	.17		
72,000	.19		
111,600			Tensile strength.
.....	.68		
			-6.8 per cent elongation in 10".

Elongation of inch sections, ".07, ".07, ".06, ".07, ".07, ".09*, ".07, ".06, ".06, ".06.

Diameter at fracture, 1".09; area, .9331 square inch.

Contraction of area, 6.7 per cent.

Position of fracture, 4.75 from the neck.

Appearance of fracture, fine granular, radiating from a dark spot at circumference.

No. 8498.

Ingot, 19" × 20".375 × 4".

Marks; 2, annealed.

Diameter, 1".129.

Sectional area, 1.00 square inch.

Gauged length, 10".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0011	0.	
10,000	.0027	-----	
30,000	.0097	-.0002	
35,000	.0112	-----	
40,000	.0132	-.0002	
45,000	.0150	0.	Elastic limit.
50,000	.0172	.0002	
51,000	.0178	-----	
52,000	.0190	-----	
53,000	.0335	-----	
54,000	.0550	-----	
55,000	.0770	-----	
56,000	.0820	-----	
57,000	.0860	-----	
58,000	.0930	-----	
59,000	.0990	-----	
60,000	.1050	-----	
64,000	.14	-----	
68,000	.17	-----	
72,000	.20	-----	Tensile strength. -3.9 per cent elongation in 10".
76,000	.24	-----	
80,000	.27	-----	
85,000	.33	-----	
90,000	.41	-----	
91,600	-----	-----	
0	.39	-----	

Elongation of inch sections, ".03, ".04, ".03, ".05, ".03, ".04, ".06*, ".03, ".04, ".04.

Diameter at fracture, 1".10; area, .9503 square inch.

Contraction of area, 5.0 per cent.

Fractured 3".60 from the neck.

Appearance of fracture, fine granular.

No. 8501.

Ingot, 19" × 20" .375 × 4".

Marks; 5, annealed.

Diameter, 1".129.

Sectional area, 1.00 square inch.

Gauged length, 10".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0013	0.	
10,000	.0033	0.	
30,000	.0102	0.	
35,000	.0118	0.	
40,000	.0138	0.	
45,000	.0155	0.	Elastic limit.
50,000	.0176	.0003	
51,000	.0184	.....	
52,000	.0850	.....	
53,000	.0910	.....	
54,000	.0960	.....	
55,000	.1010	.....	
56,000	.1100	.....	
57,000	.1180	.....	
58,000	.1240	.....	
59,000	.1315	.....	
60,000	.1405	.....	
64,000	.19	.....	
68,000	.23	.....	
72,000	.27		Tensile strength. =2.7 per cent elongation in 10".
73,800	.....	.....	
0	.27		

Elongation of inch sections, ".06*, ".02, ".02, ".04, ".02, ".02, ".03, ".02, ".03, ".01.

Diameter at fracture, 1".12; area, .9852 square inch.

Contraction of area, 1.5 per cent.

Fractured ".60 from the neck.

Appearance of fracture, fine granular.

TABULATION OF TENSION SPECIMENS FROM STEEL INGOT.

Diameter of specimens, 1" 129.
 Sectional area, 1.00 square inch.
 Gauged length, 10".

No. of test.	Marks.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Elongation of inch sections.										Appearance of fracture.
		Pounds.	Pounds.	Per cent.	Per cent.	"	"	"	"	"	"	"	"	"	"	
8492	1.....	42,000	42,000	.20	0	.00	.00	.01	.01	.01	.01	.01	.01	.02	.02	Columnar, with dark blue patch at circumference.
8493	2.....	46,120	71,200	1.6	1.5	.01	.01	.01	.01	.02	.01	.01	.01	.01	.01	Coarse, granular, flaky.
8494	3.....	42,000	62,300	1.3	1.5	.01	.01	.01	.01	.03*	.01	.01	.01	.01	.01	Do.
8495	4.....	41,000	63,300	1.3	1.5	.03*	.01	.01	.02	.01	.01	.01	.01	.02	.00	Do.
8496	5.....	41,000	64,800	1.6	1.5	.01	.01	.03	.01	.01	.01	.01	.01	.01	.06	Do.
8497	1, annealed	55,000	111,800	6.8	6.7	.07	.07	.06	.07	.09	.07	.06	.06	.06	.06	Fine granular, redisting from a dark spot at circumference.
8498	2, annealed	52,000	91,600	3.9	3.0	.06	.04	.06	.06	.04	.06*	.03	.04	.04	.04	Fine granular.
8499	3, annealed	52,000	73,900	2.2	3.2	.02	.02	.02	.03	.03*	.02	.03	.01	.02	.02	Do.
8500	4, annealed	53,000	73,100	2.6	1.6	.03	.02	.03	.03	.02	.03	.02	.03	.03	.02	Do.
8501	5, annealed	51,000	73,800	2.7	1.5	.06*	.02	.02	.04	.02	.03	.02	.03	.03	.01	Do.

RAILROAD MATERIAL.

*TENSILE TESTS OF SPECIMENS FROM HEADS OF STEEL RAILS.
MATERIAL FURNISHED BY DR. P. H. DUDLEY.*

No. 8465.

Ordinary Bessemer steel, P. R. 100 pounds. Sec. 96 A.

Heavy base, $\frac{1}{4}$ " thick at edge. Rolled cold.

Marks, 73961-1. B-4.

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0002	0.	
10,000	.0005	.....	
30,000	.0021	.....	
40,000	.0027	.....	
45,000	.0031	.....	
50,000	.0035	0.	
55,000	.0037	.....	
57,000	.0039	.....	
58,000	.0040		Elastic limit.
59,000	.0042	.....	
60,000	.0064	.....	
61,000	.0106	.....	
62,000	.0140	.....	
63,000	.0145	.....	
64,000	.0150	.....	
65,000	.0163	.....	
66,000	.0168	.....	
70,000	.0245	.....	
75,000	.03	.....	
80,000	.04	.....	
85,000	.05	.....	
90,000	.06	.....	
95,000	.08	.....	
100,000	.10	.....	
105,000	.12	.....	
110,000	.17		Tensile strength. = 13.0 per cent.
111,500	.....	.....	
0	.26		

Elongation of inch sections, ".12, ".14*.

Diameter at fracture, ".46; area, ".1662 square inch.

Contraction of area, 16.9 per cent.

Position of fracture, 1."00 from neck.

Appearance of fracture, fine granular, silky spot at circumference.

No. 8466.

Ordinary Bessemer steel, P. R. 100 pounds. Sec. 96 A.
 Marks, 73961-1. 1-H.
 Diameter, ".505.
 Sectional area, .20 square inch.
 Gauged length, 2".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0007	.....	
30,000	.0022	.....	
40,000	.0029	.....	
45,000	.0034	.....	
50,000	.0037	.0003	
55,000	.0042	.....	
57,000	.0044	.....	
58,000	.0045		Elastic limit.
59,000	.0118	.....	
60,000	.0126	.....	
61,000	.0173	.....	
62,000	.0192	.....	
63,000	.0196	.....	
64,000	.0208	.....	
65,000	.0212	.....	
70,000	.0223	.....	
75,000	.0295	.....	
80,000	.03		
85,000	.04	.....	
90,000	.05	.....	
95,000	.07	.....	
100,000	.08	.....	
105,000	.10	.....	
108,500	.14	.....	
0	.41	.....	
			Tensile strength. = 20.5 per cent.

Elongation of inch sections, ".13, ".28*.
 Diameter at fracture, ".40; area, ".1257 square inch.
 Contraction of area, 37.1 per cent.
 Position of fracture, ".80 from neck.
 Appearance of fracture, silky, interspersed with granular metal.

No. 8467.

Ordinary Bessemer steel. 100 pounds. Sec. 96 A.

Specimen previously heated in molten lead.

Marks, 73961-1. 5 B.

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0005		
30,000	.0019		
40,000	.0027		
50,000	.0034	0.	Elastic limit.
51,000	.0035		
52,000	.0036		
53,000	.0038		
	.0044		
54,000	.0100		
55,000	.0133		
56,000	.0148		
57,000	.0160		
58,000	.0168		
59,000	.0197		
60,000	.0207		
65,000	.0278		
70,000	.0385		
75,000	.05		Tensile strength. =21.5 per cent.
80,000	.06		
85,000	.07		
90,000	.08		
95,000	.11		
100,000	.15		
102,500	.43		

Elongation of inch sections, ".18, ".25*.

Diameter of fracture, ".40; area, .1257 square inch.

Contraction of area, 37.1 per cent.

Position of fracture, 1".05 from neck.

Appearance of fracture, fine granular, 50 per cent, silky, 50 per cent.

No. 8468.

Titanium steel. 85 pounds. Sec. 67 A.

Marks, 73790-1. 1-H.

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0002	0.	
10,000	.0005	.....	
30,000	.0020	.....	
40,000	.0027	.....	
45,000	.0030	.....	
50,000	.0034	0.	
55,000	.0039	.....	
60,000	.0043	.....	
63,000	.0045	.....	
64,000	.0046		Elastic limit.
65,000	.0130	.....	
66,000	.0192	.....	
67,000	.0203	.....	
68,000	.0210	.....	
69,000	.0233	.....	
70,000	.0247	.....	
75,000	.0325	.....	
80,000	.04	.....	
85,000	.05	.....	
90,000	.06		Tensile strength. =16.5 per cent.
95,000	.08	.....	
100,000	.09	.....	
105,000	.14	.....	
108,500	.....	.....	
0	.33		

Elongation of inch sections, ".16*, ".17*.

Diameter at fracture, ".44; area, .1521 square inch.

Contraction of area, 24.0 per cent.

Position of fracture, at middle of stem.

Appearance of fracture, fine granular, 90 per cent, silky, 10 per cent.

No. 8469.

Titanium steel. 85 pounds. Sec. 67 A.

Marks, 73790-1. 4-B.

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0006	.....	
30,000	.0019	.....	
40,000	.0026	.....	
45,000	.0030	.....	
50,000	.0034	0.	
55,000	.0038	.....	
60,000	.0043	.....	
63,000	.0046	.....	
64,000	.0047		Elastic limit.
65,000	.0065	.....	
66,000	.0092	.....	
67,000	.0195	.....	
68,000	.0209	.....	
69,000	.0214	.....	
70,000	.0246	.....	
75,000	.0252	.....	
80,000	.0330	.....	
85,000	.04	.....	
90,000	.05		Tensile strength. = 17.0 per cent.
95,000	.06	.....	
100,000	.08	.....	
105,000	.09	.....	
110,000	.13	.....	
110,500	.20	.....	
0	.34		

Elongation of inch sections, ".16*, ".18*.

Diameter at fracture, ".44; area, .1521 square inch.

Contraction of area, 24.0 per cent.

Position of fracture, at middle of stem.

Appearance of fracture, fine granular, silky spot at circumference.

No. 8470.

Titanium steel. 85 pounds. Sec. 67 A.
 Specimen previously heated in molten lead.
 Marks, 73790-1. 5-B.
 Diameter, ".505.
 Sectional area, .20 square inch.
 Gauged length, 2".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0002	0.	
10,000	.0006		
30,000	.0019		
40,000	.0024		
45,000	.0029		Elastic limit.
50,000	.0032	0.	
55,000	.0036		
60,000	.0040		
61,000	.0042		
62,000	.0043		
63,000	.0170		
64,000	.0190		
65,000	.0202		
66,000	.0220		
67,000	.0230		
68,000	.0242		
69,000	.0265		
70,000	.0273		
75,000	.0282		
80,000	.0385		
85,000	.05		
90,000	.06		
95,000	.06		
100,000	.09		
105,000	.12		
107,000	.18		
0	.42		Tensile strength. =21.0 per cent.

Elongation of inch sections, ".28*, ".14.
 Diameter at fracture, ".39; area, .1194 square inch.
 Contraction of area, 40.3 per cent.
 Position of fracture, 1".00 from the neck.
 Appearance of fracture, fine granular, silky center.

No. 8471.

Titanium steel. 85 pounds. Sec. 67 A.

Marks, 73790-1. 2-H.

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length. 2".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0002	0.	
10,000	.0005		
30,000	.0020		
40,000	.0026		
45,000	.0030		
50,000	.0035	.0001	
55,000	.0040		
59,000	.0044		
60,000	.0044		Elastic limit.
61,000	.0054		
62,000	.0065		
63,000	.0140		
64,000	.0158		
65,000	.0162		
66,000	.0170		
67,000	.0177		
68,000	.0202		
69,000	.0212		
70,000	.0220		
75,000	.0240		
80,000	.0313		
85,000	.04		
90,000	.05		
95,000	.06		
100,000	.07		
105,000	.08		
110,000	.11		
111,500	.17		Tensile strength.
0	.35		-17.5 per cent.

Elongation of inch sections, ".12, ".23*.

Diameter at fracture, ".43; area, .1462 square inch.

Contraction of area, 27.4 per cent.

Position of fracture, ".76 from the neck.

Appearance of fracture, fine granular, 85 per cent; silky, 15 per cent.

No. 8472.

Ordinary Bessemer steel. 100 pounds. Sec. 96 A.
 Marks, 74061-1. 2-H.
 Diameter, ".505.
 Sectional area, .20 square inch.
 Gauged length, 2".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0002	0.	
10,000	.0005		
20,000	.0012		
30,000	.0020		
35,000	.0025		
40,000	.0029		
45,000	.0034		
50,000	.0039		
55,000	.0044		
60,000	.0049		
65,000	.0057		
70,000	.0060		
71,000	.0062		
72,000	.0064		
73,000	.0065		Elastic limit.
74,000	.0066		
75,000	.0069		
76,000	.0070		
77,000	.0073		
78,000	.0076		
79,000	.0081		
80,000	.0087		
81,000	.0102		
82,000	.0122		
84,000	.0201		Tensile strength.
86,000	.0255		
100,000	.16		
103,000			-17.5 per cent elongation in 2".
0	.35		

Elongation of inch sections, ".17*, ".18*.

Diameter at fracture, ".43; area, .1452 square inch.

Contraction of area, 27.4 per cent.

Fractured at middle of stem.

Appearance of fracture, fine granular; silky spot at circumference

No. 8479.

Ordinary Bessemer steel. 100 pounds. Sec. 96 A.

Marks, 74061-1. 4-B.

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0005	.....	
20,000	.0012	.....	
30,000	.0018	.....	
40,000	.0025	.....	
45,000	.0030	.....	
50,000	.0034	0.	
55,000	.0038	.....	
58,000	.0041		Elastic limit.
59,000	.0042	.....	
60,000	.0075	.....	
61,000	.0185	.....	
62,000	.0190	.....	
63,000	.0200	.....	
64,000	.0208	.....	
65,000	.0222	.....	
66,000	.0240	.....	
67,000	.0253	.....	
68,000	.0275	.....	
69,000	.0286	.....	
70,000	.0298	.....	
75,000	.0395	.....	
80,000	.04	.....	
85,000	.05		Tensile strength. =14.5 per cent.
90,000	.07	.....	
95,000	.09	.....	
100,000	.11	.....	
105,000	.16	.....	
106,500	.....	.....	
0	.29		

Elongation of inch sections, ".11, ".18*.

Diameter at fracture, ".45; area, .1590 square inch.

Contraction of area, 20.5 per cent.

Position of fracture, ".40 from the neck.

Appearance of fracture, fine granular, silky spot at circumference.

Opened short transverse cracks in stem.

No 8480.

Ordinary Bessemer steel. 100 pounds. Sec. 96 A.

Specimen previously heated in molten lead.

Marks, 74061-1. 5-B.

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0005	.....	
20,000	.0011	.....	
30,000	.0018	.....	
40,000	.0025	.....	
45,000	.0030		Elastic limit.
50,000	.0033	0.	
52,000	.0035	.....	
53,000	.0037	.....	
54,000	.0116	.....	
55,000	.0150	.....	
56,000	.0163	.....	
57,000	.0178	.....	
58,000	.0188	.....	
59,000	.0200	.....	
60,000	.0216		Tensile strength. —21.0 per cent.
65,000	.0295	.....	
70,000	.0390	.....	
75,000	.0485	.....	
80,000	.06	.....	
85,000	.08	.....	
90,000	.09	.....	
95,000	.12	.....	
100,000	.16	.....	
103,000	.....	.....	
0	.42		

Elongation of inch sections, ".22*, ".20*.

Diameter at fracture, ".42; area, 1385 square inch.

Contraction of area, 30.7 per cent.

Position of fracture, at middle of stem.

Appearance of fracture, fine granular, silky spot at circumference.

No. 8481-

Ordinary Bessemer steel. 100 pounds. Sec. 96 A.

Marks, 74061-1. 1-H.

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0002	0.	
10,000	.0005	.....	
20,000	.0012	.....	
30,000	.0019	.....	
40,000	.0027		Elastic limit.
45,000	.0030	.....	
50,000	.0035	.0001	
54,000	.0038	.....	
55,000	.0039	.....	
56,000	.0042	.....	
57,000	.0170	.....	
58,000	.0180	.....	
59,000	.0193	.....	
60,000	.0210	.....	
61,000	.0225	.....	
62,000	.0245	.....	
65,000	.0270	.....	
70,000	.0361	.....	
75,000	.0464	.....	
80,000	.05		Tensile strength. = 18.0 per cent.
85,000	.07	.....	
90,000	.09	.....	
95,000	.11	.....	
100,000	.14	.....	
103,500			
0	.36		

Elongation of inch sections, ".21*, ".15.

Diameter at fracture, ".43; area, .1462 square inch.

Contraction of area, 27.4 per cent.

Position of fracture, ".95 from the neck.

Appearance of fracture, fine granular 80 per cent, silky, 20 per cent.

No. 8482.

Ordinary Bessemer steel. 100 pounds. Sec. 96 A.

Marks, 74061-1. 3-H.

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0007	.....	
20,000	.0014	.....	
30,000	.0023	.....	
40,000	.0030		Elastic limit.
45,000	.0035	.....	
50,000	.0038	0.0001	
53,000	.0041	.....	
54,000	.0042	.....	
55,000	.0045	.....	
56,000	.0070	.....	
57,000	.0160	.....	
58,000	.0178	.....	
59,000	.0189	.....	
60,000	.0200	.....	
61,000	.0220	.....	
62,000	.0236	.....	
63,000	.0248	.....	
65,000	.0270	.....	
70,000	.0380		Tensile strength. = 14.0 per cent.
75,000	.0465	.....	
80,000	.06	.....	
85,000	.07	.....	
90,000	.09	.....	
95,000	.11		
100,000	.15	.....	
103,000	.....	.....	
0	.28		

Elongation of inch sections, ".15*, ".13.

Diameter at fracture, ".46; area, .1662 square inch.

Contraction of area, 16.9 per cent.

Position of fracture, ".65 from the neck.

Appearance of fracture, fine granular, small silky spot at circumference. Opened short transverse cracks in stem.

No. 8483.

Ordinary Bessemer steel. 100 pounds. Sec. 96 A.

Specimen previously heated in molten lead.

Marks, 74061-1. 6-B.

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0002	0.	
10,000	.0004		
20,000	.0010		
30,000	.0017		
40,000	.0024		
45,000	.0028		
50,000	.0033	— .0002	
53,000	.0034		
54,000	.0035		Elastic limit.
55,000	.0050		
56,000	.0140		
57,000	.0155		
58,000	.0167		
59,000	.0180		
60,000	.0200		
61,000	.0208		
62,000	.0226		
65,000	.0250		
70,000	.0355		
75,000	.0440		
80,000	.05		
85,000	.06		
90,000	.07		
95,000	.10		
100,000	.13		
105,000	.24		Tensile strength.
0	.43		—21.5 per cent.

Elongation of inch sections, ".26*, ".17.

Diameter at fracture, ".40; area, .1257 square inch.

Contraction of area, 37.1 per cent.

Position of fracture, 1".05 from the neck.

Appearance of fracture, fine granular.

No. 8484.

Ordinary Bessemer steel. 100 pounds. Sec. 96 A.
 Specimen previously heated in molten lead.
 Marks, 74061-1. 7-B.
 Diameter, ".505.
 Sectional area, .20 square inch.
 Gauged length, 2".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0007	.....	
20,000	.0013	.....	
30,000	.0022	.....	
40,000	.0028		Elastic limit.
45,000	.0033	.....	
50,000	.0036	.0001	
55,000	.0042	.....	
56,000	.0195	.....	
57,000	.0204	.....	
58,000	.0218	.....	
59,000	.0233	.....	
60,000	.0254	.....	
61,000	.0275	.....	
62,000	.0290	.....	
65,000	.0333	.....	
70,000	.0420	.....	
75,000	.0540	.....	
80,000	.07	.....	
85,000	.08	.....	
90,000	.10	.....	
95,000	.14	.....	
100,000	.21		Tensile strength. =25.0 per cent.
100,500	.....	.....	
0	.50		

Elongation of inch sections, ".25*, ".25*.
 Diameter at fracture, ".37; area, .1075 square inch.
 Contraction of area, 46.2 per cent.
 Position of fracture, at middle of stem.
 Appearance of fracture, silky.

No. 8485.

Titanium steel. 85 pounds. Sec. 67 A.

Marks, 73790-1. 3-H.

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0007	.....	
20,000	.0013	.....	
30,000	.0020	.....	
40,000	.0027	.....	
45,000	.0030	.....	
50,000	.0035	0.	
55,000	.0038	.....	
60,000	.0044	.....	
63,000	.0045		Elastic limit.
64,000	.0046	.....	
65,000	.0047	.....	
66,000	.0198	.....	
67,000	.0210	.....	
68,000	.0225	.....	
69,000	.0235	.....	
70,000	.0250	.....	
75,000	.0275	.....	
80,000	.0350	.....	
85,000	.05		Tensile strength. =13.5 per cent.
90,000	.06	.....	
95,000	.07	.....	
100,000	.08	.....	
105,000	.10	.....	
110,000	.13	.....	
0	.27		

Elongation of inch sections, ".13, ".14*.

Diameter at fracture, ".46; area, .1662 square inch.

Contraction of area, 16.9 per cent.

Position of fracture, 1".10 from the neck.

Appearance of fracture, fine granular. Fracture started at circumference of stem.

No. 8486.

Titanium steel. 85 pounds. Sec. 67 A.
 Specimen previously heated in molten lead.
 Marks, 73790-1. 6-B.
 Diameter, ".505.
 Sectional area, .20 square inch.
 Gauged length, 2".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0002	0.	
10,000	.0005	.....	
20,000	.0011	.....	
30,000	.0020	.....	
40,000	.0028	.....	
45,000	.0030	.....	
50,000	.0035	0.	
55,000	.0038	.....	
57,000	.0040	.....	
58,000	.0042		Elastic limit.
59,000	.0075	.....	
60,000	.0187	.....	
61,000	.0205	.....	
62,000	.0212	.....	
63,000	.0224	.....	
64,000	.0230	.....	
65,000	.0242	.....	
70,000	.0330	.....	
75,000	.0425	.....	
80,000	.06	.....	
85,000	.06	.....	
90,000	.08	.....	
95,000	.10	.....	
100,000	.13	.....	
105,000	.21		Tensile strength. -22.5 per cent.
105,500	.....	.....	
0	.45		

Elongation of inch sections, ".29*, ".16.

Diameter at fracture, ".38; area, .1134 square inch.

Contraction of area, 43.3 per cent.

Position of fracture, 1".05 from the neck.

Appearance of fracture, silky, interspersed with fine granular metal.

No. 8487.

Titanium steel. 85 pounds. Sec. 67 A.
 Specimen previously heated in molten lead.
 Marks, 73790-1. 7-B.
 Diameter, ".505.
 Sectional area, .20 square inch.
 Gauged length, 2".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0002	0.	
10,000	.0005		
20,000	.0011		
30,000	.0017		
40,000	.0023		
45,000	.0027		
50,000	.0030	— .0001	
55,000	.0034		
60,000	.0038		
61,000	.0039		Elastic limit.
62,000	.0040		
63,000	.0245		
64,000	.0250		
65,000	.0257		
66,000	.0262		
67,000	.0270		
68,000	.0285		
69,000	.0308		
70,000	.0326		
75,000	.0418		Tensile strength. — 22.5 per cent.
80,000	.05		
85,000	.06		
90,000	.08		
95,000	.10		
100,000	.14		
104,500			
0	.45		

Elongation of inch sections, ".24*, ".21.
 Diameter at fracture, ".39; area, .1194 square inch.
 Contraction of area, 40.3 per cent.
 Position of fracture, at middle of stem.
 Appearance of fracture, fine granular, 70 per cent; silky, 30 per cent.

No. 8488.

Ordinary Bessemer steel. 100 pounds. Sec. 96 A.

Marks, 73961-1. 2-H.

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0006	.....	
20,000	.0013	.....	
30,000	.0021	.....	
40,000	.0029	.....	
45,000	.0032	.....	
50,000	.0037	.0002	
53,000	.0040	.....	
54,000	.0041		Elastic limit.
55,000	.0043	.....	
56,000	.0047	.....	
57,000	.0135	.....	
58,000	.0145	.....	
59,000	.0155	.....	
60,000	.0170	.....	
61,000	.0183	.....	
62,000	.0195	.....	
65,000	.0288	.....	
70,000	.0313	.....	
75,000	.0395	.....	
80,000	.05	.....	
85,000	.06	.....	
90,000	.07	.....	
95,000	.09	.....	
100,000	.11		Tensile strength. = 17.5 per cent.
105,000	.16	.....	
107,000	.....	.....	
0	.35		

Elongation of inch sections, ".13, ".22*.

Diameter at fracture, ".44; area, .1521 square inch.

Contraction of area, 24.0 per cent.

Position of fracture, ".78 from the neck.

Appearance of fracture, fine granular, silky spot at circumference.

No. 8489.

Ordinary Bessemer steel. 100 pounds. Sec. 96 A.
 Marks, 73961-1. 3-H.
 Diameter, ".505.
 Sectional area, .20 square inch.
 Gauged length, 2".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0002	0.	
10,000	.0005	.....	
20,000	.0012	.....	
30,000	.0019	.....	
40,000	.0025	.....	
45,000	.0029	.....	
50,000	.0033	0.	
55,000	.0036	.....	
57,000	.0038	.....	
58,000	.0038		Elastic limit.
59,000	.0040	.....	
60,000	.0042	.....	
61,000	.0175	.....	
62,000	.0183	.....	
63,000	.0194	.....	
64,000	.0204	.....	
65,000	.0217	.....	
70,000	.0232	.....	
75,000	.0385	.....	
80,000	.05		Tensile strength. =20.0 per cent.
85,000	.06	.....	
90,000	.07	.....	
95,000	.08	.....	
100,000	.11	.....	
105,000	.14	.....	
108,000	.....	.....	
0	.40		

Elongation of inch sections, ".25*, ".15.

Diameter at fracture, ".41; area, .1320 square inch.

Contraction of area, 34.0 per cent.

Position of fracture, ".95 from the neck.

Appearance of fracture, fine granular, silky spot near circumference.

No. 8490.

Ordinary Bessemer steel. 100 pounds. Sec. 96 A.

Specimen previously heated in molten lead.

Marks, 73961-1. 6-B.

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0002	0.	
10,000	.0006	.....	
20,000	.0012	.....	
30,000	.0020	.....	
40,000	.0026	.....	
45,000	.0030	.....	
50,000	.0035	0.	
51,000	.0036	.....	
52,000	.0038		Elastic limit.
53,000	.0062	.....	
54,000	.0143	.....	
55,000	.0158	.....	
56,000	.0175	.....	
57,000	.0182	.....	
58,000	.0193	.....	
59,000	.0200	.....	
60,000	.0220	.....	
65,000	.0285		Tensile strength. =23.0 per cent.
70,000	.0375	.....	
75,000	.0475	.....	
80,000	.06	.....	
85,000	.07	.....	
90,000	.08	.....	
95,000	.11	.....	
100,000	.16	.....	
103,000	.....	.....	
0	.46		

Elongation of inch sections, ".15, ".31*.

Diameter at fracture, ".40; area, .1257 square inch.

Contraction of area, 37.1 per cent.

Position of fracture, ".90 from the neck.

Appearance of fracture, fine granular, 80 per cent; silky, 20 per cent.

No 8491.

Ordinary Bessemer steel. 100 pounds. Sec. 96 A.

Specimen previously heated in molten lead.

Marks, 73961-1. 7-B.

Diameter, ".505.

Sectional area, .20 square inch.

Gauged length, 2".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,000	0.	0.	Initial load.
5,000	.0002	0.	
10,000	.0006	.....	
20,000	.0011	.....	
30,000	.0018	.....	
40,000	.0024	.....	
45,000	.0027	.....	
50,000	.0031	0.	
54,000	.0035	.....	
55,000	.0037		Elastic limit.
56,000	.0038	.....	
57,000	.0160	.....	
58,000	.0168	.....	
59,000	.0175	.....	
60,000	.0190	.....	
61,000	.0212	.....	
62,000	.0223	.....	
63,000	.0235	.....	
65,000	.0257	.....	
70,000	.0345		Tensile strength. —22.5 per cent.
75,000	.0425	.....	
80,000	.05	.....	
85,000	.08	.....	
90,000	.08	.....	
95,000	.10	.....	
100,000	.13	.....	
105,000	.23	.....	
0	.45	.....	

Elongation of inch sections, ".12, ".33 *.

Diameter at fracture, ".38; area, .1134 square inch.

Contraction of area, 43.3 per cent.

Position of fracture, ".76 from the neck.

Appearance of fracture, fine granular, silky center.

TABULATION OF TENSION SPECIMENS FROM STEEL RAILS.

No. of test.	Marks.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 2 inches.	Contraction of area.	Elongation of sections.	Appearance of fracture.
8465	73861-1. B-A.	Pounds. 59,000	Pounds. 111,500	Per cent. 13.0	Per cent. 16.9	" 12.14*	Fine granular, silky spot at circumference.
8466	73861-1. 1-H.	58,000	108,500	20.5	37.1	13.28*	Silky, interspersed with granular metal.
8467	73861-1. 6-B.	52,000	102,500	21.5	37.1	18.25*	Fine granular, 50 per cent; silky, 50 per cent.
8468	73790-1. 1-H.	64,000	109,500	16.5	24.0	16*.17*	Fine granular, 90 per cent; silky, 10 per cent.
8469	73790-1. 4-B.	61,000	110,500	17.0	24.0	16*.18*	Fine granular, silky spot at circumference.
8470	73790-1. 7-B.	61,000	107,000	21.0	40.3	28*.14	Fine granular, silky center.
8471	73790-1. 2-H.	60,000	111,500	17.5	27.4	12.23*	Fine granular, 85 per cent; silky, 15 per cent.
8472	74061-1. 2-H.	76,000	103,000	17.5	27.4	17*.18*	Fine granular, silky spot at circumference.
8479	74061-1. 4-B.	59,000	106,500	14.5	20.5	11.18*	Fine granular, silky spot at circumference.
8480	74061-1. 5-B.	53,000	103,000	21.0	30.7	22*.20*	Opened short transverse cracks in stem.
8481	74061-1. 1-H.	55,000	103,500	18.0	27.4	21*.15	Fine granular, 80 per cent; silky, 20 per cent.
8482	74061-1. 3-H.	54,000	103,000	14.0	16.9	15*.13	Fine granular, small silky spot at circumference.
8483	74061-1. 7-B.	54,000	105,000	21.5	37.1	26*.17	Opened short transverse cracks on stem.
8484	74061-1. 6-B.	55,000	100,500	25.0	46.2	25*.25*	Silky.
8485	73790-1. 1-H.	65,000	110,500	13.5	16.9	13*.14*	Fine granular. Fracture started at circumference of stem.
8486	73790-1. 3-H.	58,000	105,500	22.5	43.3	29*.16	Silky, interspersed with fine granular metal.
8487	73790-1. 7-B.	62,000	104,500	22.5	40.3	24*.21	Fine granular, 70 per cent; silky, 30 per cent.
8488	73790-1. 2-H.	55,000	107,000	17.5	24.0	13.22*	Fine granular, silky spot at circumference.
8489	73861-1. 3-H.	60,000	103,000	20.0	34.0	15.25*	Fine granular, silky spot near circumference.
8490	73861-1. 6-B.	52,000	108,000	23.0	37.1	15.31*	Fine granular, 80 per cent; silky, 20 per cent.
8491	73861-1. 7-B.	56,000	105,000	22.5	43.3	12.33*	Fine granular, silky center.



STEEL RAILS.

TRANSVERSE TESTS.

STEEL RAILS.

TRANSVERSE TESTS OF STEEL RAILS CONTRIBUTED BY MR. R. TRIMBLE,
CHIEF ENGINEER OF MAINTENANCE OF WAY, NORTHWEST SYSTEM,
PENNSYLVANIA LINES, PITTSBURG, PA.

Three sections, 5 feet long each, were taken from each of the 13 rails contributed and tests made by means of transverse loads. A common length of 54 inches between end bearings was maintained throughout the tests. The loads were applied at the middle of the spans. A number of the rail sections were loaded on the heads, others on the bases, thus bringing the metal of the bases and heads respectively, into tension during the tests.

The rails were tested in the condition they came from the track, all having been in service, excepting three specimens which were annealed before testing. The annealing was done by heating the sections to a full red color and cooling over night in the furnace.

The sections were much worn, the heights and weights per yard being given for the sections, as they were tested. Diagrams accompanying the details of the tests show the worn shapes of the rails in cross section.

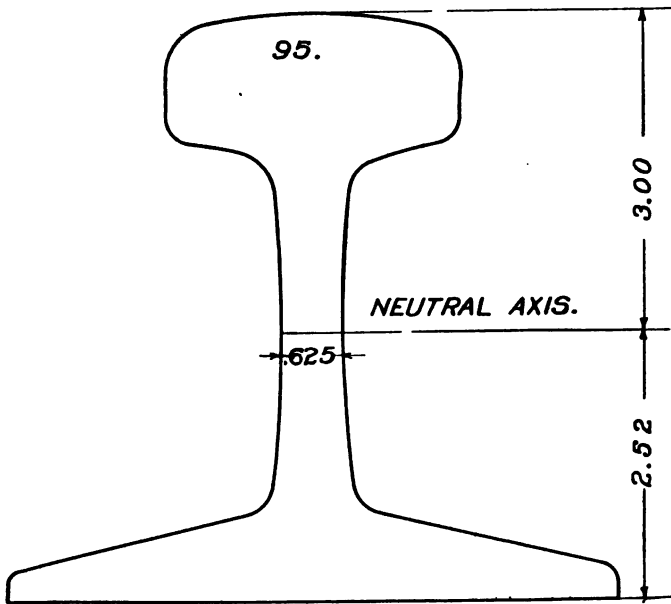
The rails which were tested with the bases in tension commonly reached their maximum loads without rupture, and were bent still further under diminished stresses without rupture of the metal. Those sections which were tested with the metal of the head in tension ruptured under lower maximum stresses and displayed brittleness in the fractures. The annealed specimens, however, bent without rupture, the metal of the heads being in tension.

One section was tested alternately in opposite directions, the effect of reversed loads on the deflections and sets being shown by the details of the test.

The apparent moduli of elasticity were computed from the deflections after deducting the sets. The relative behavior of the several sections is shown substantially by these values, which are, however, below the real ones on account of the measured deflections necessarily including the yielding of the bearing blocks of the testing fixtures with the actual deflections of the rail sections. The elastic limits of the rails are vague. They also are approximately stated in the tabulation of the results, being given at those loads at which there occurred an increase in the rate of yielding and after which there was a progressive gain in the rate of deflection.

Chemical analyses of steel rails.

Description.	Carbon.	Manga- nese.	Silicon.	Sulphur.	Phos- phorus.
Rail No. 95 (Transverse test No. 756).....	0.43	0.702	0.080	0.041	0.067
Rail No. 96 (Transverse test No. 759).....	.50	.761	.065	.069	.114
Rail No. 97 (Transverse test No. 762).....	.43	.554	.053	.039	.056
Rail No. 98 (Transverse test No. 765).....	.55	.625	.054	.053	.109
Rail No. 99 (Transverse test No. 768).....	.38	.700	.063	.053	.089
Rail No. 100 (Transverse test No. 771).....	.50	.652	.051	.051	.076
Rail No. 101 (Transverse test No. 774).....	.48	.600	.065	.052	.099
Rail No. 107 (Transverse test No. 777).....	.50	.640	.058	.060	.100



I - 37.55

No. 756.

STEEL RAIL No. 95.

First specimen.

Section of old rail, branded, "Carnegie 1902 E T 1111."

Height, 5" 52.

Width of base, 5" 75.

Weight per yard, 92.4 pounds.

Ends supported 54" apart.

Loaded on head at the middle.

Additional marks, No. 1, P. F. C.

Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
927	1,000	0.	0.	Initial load.
9,270	10,000	.034	.001	
18,540	20,000	.066	.002	
27,810	30,000	.099	.003	
32,445	35,000	.115		
37,080	40,000	.131	.003	
38,934	42,000	.137		
40,788	44,000	.145		
42,642	46,000	.152		
44,496	48,000	.158		
46,350	50,000	.165	.005	
48,204	52,000	.172		
50,058	54,000	.179		
51,912	56,000	.186		
53,766	58,000	.194		
55,620	60,000	.201	.009	
57,474	62,000	.210		
59,328	64,000	.217		
61,182	66,000	.227		
63,036	68,000	.235		Elastic limit, approximate.
64,890	70,000	.244	.019	
66,744	72,000	.254		
68,598	74,000	.265		
70,452	76,000	.278		
72,306	78,000	.297		
74,160	80,000	.322	.061	
76,014	82,000	.342		
77,868	84,000	.380		
79,722	86,000	.423		
81,576	88,000	.462		
83,430	90,000	.509	.212	
136,000	146,700	.....		Maximum load applied.

Rail not fractured.

Rail recovered in deflection ".62 when load was reduced from 136,000 to 1,000 pounds per square inch fiber stress.

Permanent deflection, 21 degrees.



RAIL NO. 95.

1ST. AND 2D. SPECIMENS.

1ST. SPECIMEN, UPPER FIGURE, LOADED ON THE HEAD. BENT 21° WITHOUT FRACTURE.

2D. SPECIMEN, LOWER FIGURE, LOADED ON THE BASE. FRACTURED, PERMANENT DEFLECTION, $4\frac{1}{2}$ DEGREES.

No. 757.

STEEL RAIL No. 95.

Second specimen.

Section of old rail, branded, "Carnegie 1902 E T 1111."

Height, 5".52.

Width of base, 5".75.

Weight per yard, 91.2 pounds.

Ends supported 54" apart.

Loaded on base at the middle.

Additional marks, No. 1, P. F. C.

Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
927	1,000	0.	0.	Initial load.
9,270	10,000	.031	.001	
18,540	20,000	.063	.001	
27,810	30,000	.095	.002	
32,445	35,000	.112	.....	
37,080	40,000	.128	.003	
41,715	45,000	.145	.....	
46,350	50,000	.161	.004	
50,985	55,000	.179	.....	
55,620	60,000	.199	.010	
102,800	110,900			Ultimate strength.

Fractured at middle of length.

Appearance, medium granular, starting from the outside edge of the running surface of the head.

Permanent deflection, $4\frac{1}{2}$ degrees.

No. 758.

STEEL RAIL No. 95.

Third specimen.

Section of old rail, branded, "Carnegie 1902 E T 1111."

Height, 5".52.

Width of base, 5".75.

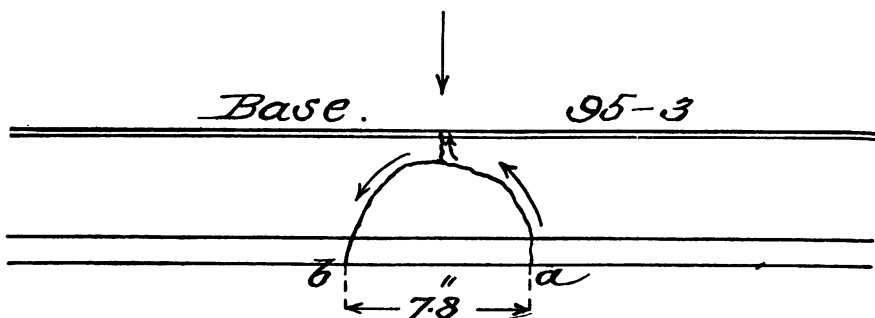
Weight per yard, 92.4 pounds.

Ends supported 54" apart.

Loaded on base at the middle.

Additional marks, No. 1, P. F. C.

Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
927	1,000	0.	0.	Initial load.
9,270	10,000	.032	.001	
18,540	20,000	.065	.002	
27,810	30,000	.097	.002	
32,445	35,000	.114	.....	
37,080	40,000	.130	.003	
41,715	45,000	.147	.....	
46,350	50,000	.163	.005	
50,985	55,000	.180	.....	
55,620	60,000	.198	.009	
60,255	65,000	.219	.....	
64,890	70,000	.243	.021	
92,700	100,000			Snapping sounds. Ultimate strength.
102,300	110,400	.....	.....	



Fractured at middle of length. Appearance medium granular. Fracture began at the outside edge of the running surface of the head. The fracture commenced at point "a," as sketched, took a semi-circular course, and terminated at point "b," detaching a piece 7".8 long, measured on the head. Another fracture developed, branching from the principal semicircular one and extending through the base, thus separating the ends of the rail.

There were short transverse fractures started in the fin of metal on the outside edge of the head of the semicircular detached fragment.

Permanent deflection, 4 degrees.



RAIL NO. 95.

30. SPECIMEN.

RUNNING SURFACE OF HEAD. PIECE 7".8 LONG. SHORT TRANSVERSE FRACTURES DEVELOPED DURING THE TEST.



RAIL NO. 95.

3D. SPECIMEN.

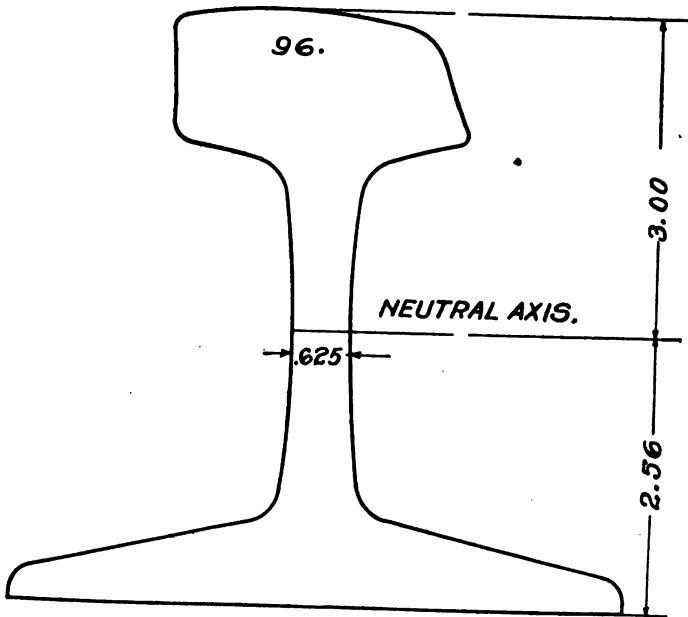
SIDE VIEW, AFTER FRACTURE, PARTS PLACED IN THEIR RELATIVE POSITIONS.



RAIL NO. 95.

3D. SPECIMEN.

PIECE 7".8 LONG. END AT WHICH LINE OF FRACTURE BEGAN.



$$I = 35.65$$

No. 759.

STEEL RAIL No. 96.

First specimen.

Section of old rail branded, "Carnegie 1902 E T 11111."

Height, 5".56.

Width of base, 5".75.

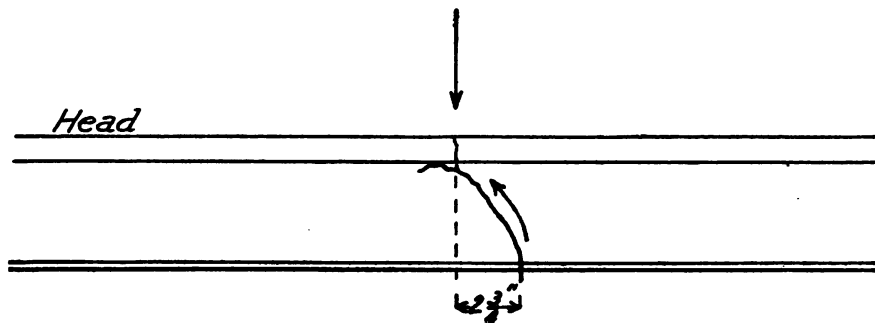
Weight per yard, 92.2 pounds.

Ends supported 54" apart.

Loaded on head at the middle.

Additional marks, No. 2, P. F. C.

Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
880	1,000	0.	0.	Initial load.
8,800	10,000	.043	.005	
17,600	20,000	.078	.007	
26,400	30,000	.112	.008	
30,800	35,000	.129	.....	
35,200	40,000	.145	.010	
39,600	45,000	.161	.....	
44,000	50,000	.177	.011	
48,400	55,000	.194	.....	
52,800	60,000	.210	.015	
54,560	62,000	.218	.....	
56,320	64,000	.225	.....	
58,080	66,000	.232	.....	
59,840	68,000	.239	.020	
61,600	70,000	.246	.021	
63,360	72,000	.255	.....	
65,120	74,000	.263		Elastic limit, approximate.
66,880	76,000	.270	.....	
68,640	78,000	.279	.....	
70,400	80,000	.289	.033	
72,160	82,000	.299	.....	
73,920	84,000	.313	.....	
75,680	86,000	.328	.....	
77,440	88,000	.348	.....	
79,200	90,000	.373	.084	
80,960	92,000	.393	.....	
82,720	94,000	.423		Ultimate strength.
84,480	96,000	.458	.....	
86,240	98,000	.494	.....	
88,000	100,000	.539	.212	
123,200	140,000	.....	.....	





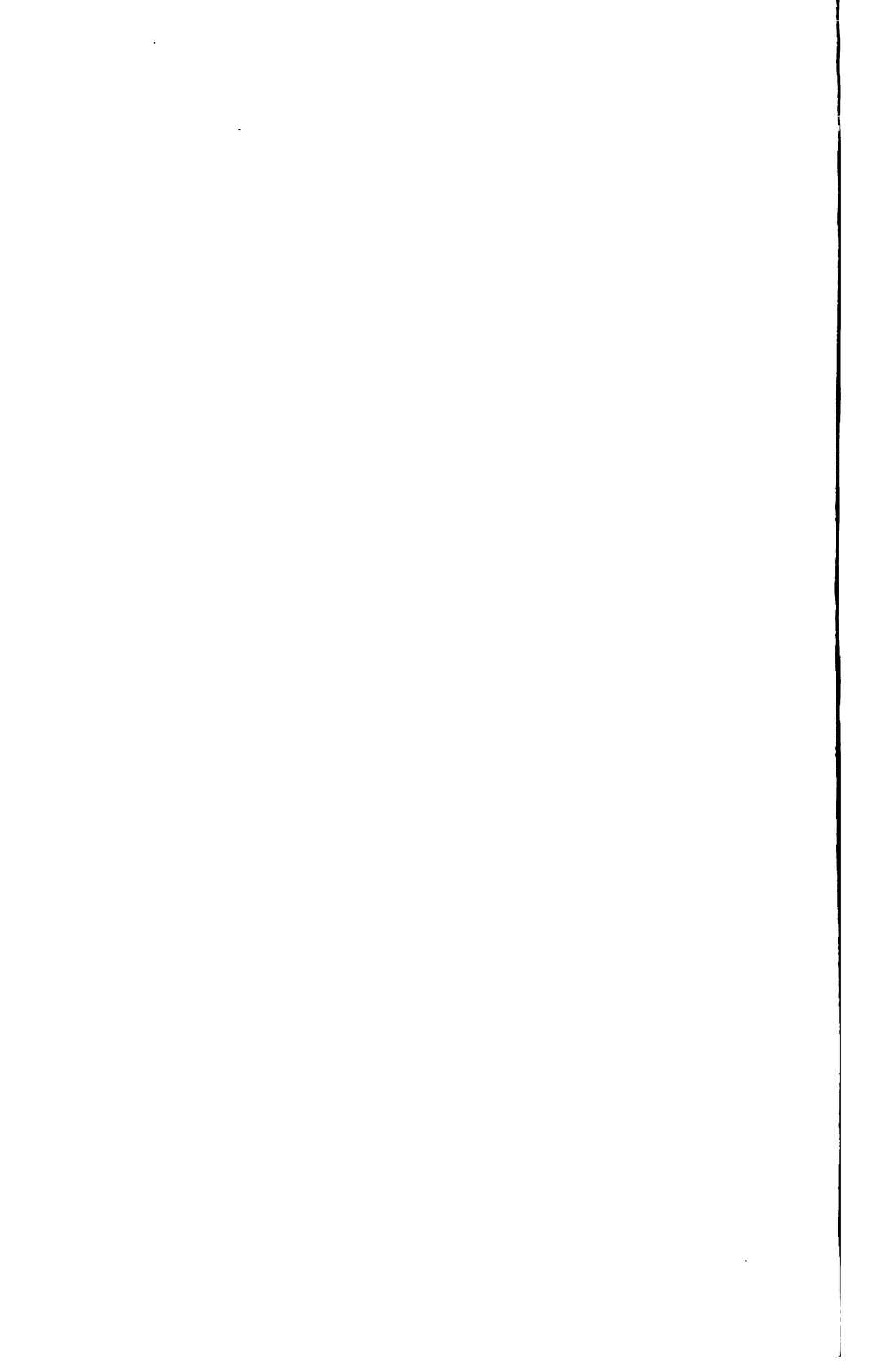
RAIL NO. 96.

1ST. SPECIMEN.

FRACTURED SURFACE. LINE OF FRACTURE BEGAN AT AN INDENTED SPOT ON UPPER EDGE OF OUTER FLANGE.



RAIL NO. 96.
1ST. SPECIMEN.
SIDE VIEW OF FRACTURE.



Fractured, beginning at a slightly indented spot, such as might be made with a hammer, in the upper edge of the outer flange. Appearance, medium granular. The fracture extended across the base, through the web, and along under the head for a distance of about an inch. The fracture branched off and passed up through the head, thus separating the rail.

Permanent deflection, 8 degrees.

No. 760.

STEEL RAIL No. 96.

Second specimen.

Section of old rail, branded, "Carnegie 1902 E T 11111."

Height, 5".56.

Width of base, 5".75.

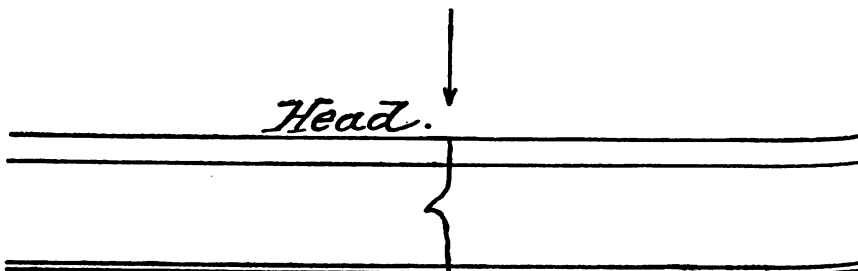
Weight per yard, 92.9 pounds.

Ends supported 54" apart.

Loaded on base at the middle.

Additional marks, No. 2, P. F. C.

Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
880	1,000	0.	0.	
8,800	10,000	.032	.000	
17,600	20,000	.066	.001	
26,400	30,000	.099	.001	
30,800	35,000	.115	.....	
35,200	40,000	.131	.002	
39,600	45,000	.148	.....	
44,000	50,000	.163	.004	
48,400	55,000	.180	.....	
52,800	60,000	.197	.006	
57,200	65,000	.215	.....	
61,600	70,000	.234	.013	Ultimate strength.
100,700	114,400	.....	.....	



Fracture began at the inside edge of the running surface of the head at a place where the metal had flowed and formed a thin fin, apparently due to the wheel pressures.

Appearance, medium granular.

Permanent deflection, $1\frac{1}{2}$ degrees.



RAIL NO. 96.
3D. SPECIMEN.
APPEARANCE OF FRACTURED SURFACE.

No. 761.

STEEL RAIL No. 96.

Third specimen.

Section of old rail, branded, "Carnegie 1902 E T 11111."

Height, 5".56.

Width of base, 5".75.

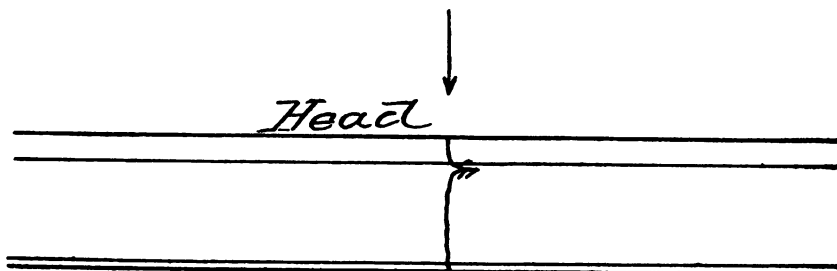
Weight per yard, 93.5 pounds.

Ends supported 54" apart.

Loaded on head at the middle.

Additional marks, No. 2, P. F. C.

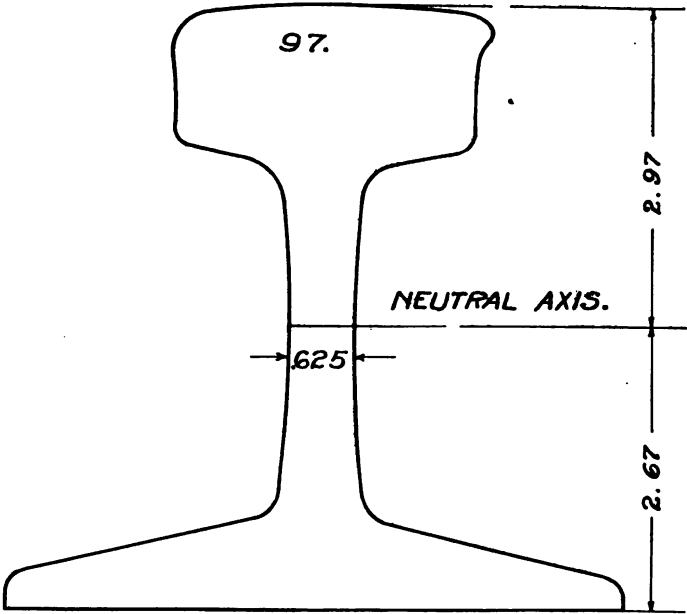
Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
880	1,000	0.	0.	Initial load.
8,800	10,000	.048	.006	
17,600	20,000	.078	.010	
26,400	30,000	.113	.013	
30,800	35,000	.129		
35,200	40,000	.144	.015	
39,600	45,000	.160		
44,000	50,000	.176	.019	
48,400	55,000	.193		
52,800	60,000	.211	.025	
54,560	62,000	.219		
56,320	64,000	.225		
58,080	66,000	.234		
59,840	68,000	.242		Elastic limit, approximate.
61,600	70,000	.251	.035	
63,360	72,000	.260		
65,120	74,000	.270		
66,880	76,000	.279		
68,640	78,000	.288		
70,400	80,000	.299	.053	
72,160	82,000	.311		
73,920	84,000	.322		
75,680	86,000	.335		
77,440	88,000	.350		
79,200	90,000	.371	.065	
80,960	92,000	.393		
82,720	94,000	.416		
84,480	96,000	.446	.149	
134,200	152,500			Ultimate strength.



Fractured at the middle of length of specimen. Appearance, granular.

Fracture began near middle of thickness of flange $\frac{7}{8}$ " from center line of web.

Permanent deflection, $12\frac{1}{2}$ degrees.



$I = 41.62$

No. 762.

STEEL RAIL No. 97.

First specimen.

Section of old rail, branded, "Carnegie 1902 E T 11111."

Height, 5".64.

Width of base, 5".75.

Weight per yard, 94.2 pounds.

Ends supported 54" apart.

Loaded on head at the middle.

Additional marks, No. 3, P. F. C.

Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,038	1,000	0.	0.	Initial load.
10,380	10,000	.046	.002	
20,760	20,000	.083	.002	
31,140	30,000	.118	.002	
36,330	35,000	.135		
41,520	40,000	.153	.003	
46,710	45,000	.170		
51,900	50,000	.189	.006	
57,090	55,000	.209		
62,280	60,000	.232	.015	Elastic limit, approximate.
64,356	62,000	.243		
66,432	64,000	.256		
68,508	66,000	.273		
70,584	68,000	.301		
72,660	70,000	.334	.079	
74,736	72,000	.365		
76,812	74,000	.406		
78,888	76,000	.459		
80,964	78,000	.508		
83,040	80,000	.565	.269	
122,200	117,700			Ultimate strength.

Rail deflected obliquely downward.

Loads continued after passing the maximum.

Permanent deflection, 18½ degrees.

Rail not fractured.

No. 763.

STEEL RAIL No. 97.

Second specimen.

Section of old rail, branded, "Carnegie 1902 E T 11111."

Height, 5".64.

Width of base, 5".75.

Weight per yard, 93.6 pounds.

Ends supported 54" apart.

Loaded on base at the middle.

Additional marks, No. 3, P. F. C.

Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	
1,038	1,000	0.	0.	Initial load.
10,380	10,000	.037	.002	
31,140	30,000	.113	.005	
36,330	35,000	.131		
41,520	40,000	.149	.006	
46,710	45,000	.168		
51,900	50,000	.188	.009	
57,090	55,000	.210		
62,280	60,000	.241	.028	Elastic limit, approximate.
64,356	62,000	.256		
66,432	64,000	.273	.048	
68,508	66,000	.297	.064	
70,584	68,000	.32		
72,660	70,000	.35		
74,736	72,000	.40		
76,812	74,000	.44		
78,888	76,000	.48		
80,964	78,000	.55		
83,040	80,000	.62		
85,116	82,000	.69		
87,192	84,000	.76		
89,268	86,000	.85		
91,344	88,000	.91		
93,420	90,000	1.03		
101,000	97,300			Ultimate strength.

Rail fractured.

Appearance granular, radiating from the inside edge of the running surface of the head.

Permanent deflection, $3\frac{1}{2}$ degrees.



RAIL NO. 97.
2D. SPECIMEN.
APPEARANCE OF FRACTURED SURFACE.

No. 764.

STEEL RAIL NO. 97.

Third specimen.

Section of old rail, branded, "Carnegie 1902 E T 11111."

Height, 5" 64.

Width of base, 5" .75.

Weight per yard, 96.6 pounds.

Ends supported 54" apart.

Loaded on head at the middle.

Additional marks, No. 3, P. F. C.

Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	
1,038	1,000	0.	0.	Initial load.
10,380	10,000	.038	.002	
20,760	20,000	.075	.003	
31,140	30,000	.111	.004	
36,330	35,000	.129	.....	
41,520	40,000	.147	.005	
46,710	45,000	.166	.....	
51,900	50,000	.186	.009	
57,090	55,000	.209	.....	
62,280	60,000	.234	.023	Elastic limit, approximate.
64,356	62,000	.247	.....	
66,432	64,000	.265	.....	
68,508	66,000	.289	.....	
70,584	68,000	.314	.....	
72,660	70,000	.344	.085	
Rail reversed in position and loaded on the base.				
1,038	1,000	0.	0.	Initial load.
10,380	10,000	.037	.006	
20,760	20,000	.080	.014	
31,140	30,000	.127	.027	
36,330	35,000	.152	.....	
41,520	40,000	.179	.043	
46,710	45,000	.207	.....	
51,900	50,000	.238	.066	
Rail again reversed in position, returning to the first position and loading on the head.				
1,038	1,000	0.	0.	Micrometer reset at zero.
10,380	10,000	.037	.002	
20,760	20,000	.076	.005	
31,140	30,000	.116	.010	
36,330	35,000	.137	.....	
41,520	40,000	.158	.017	
46,710	45,000	.181	.....	
51,900	50,000	.205	.028	
57,090	55,000	.230	.....	
62,280	60,000	.256	.044	Elastic limit, approximate.
72,660	70,000	.323	.075	
74,736	72,000	.346	.....	
76,812	74,000	.384	.....	
78,888	76,000	.427	.....	
80,964	78,000	.486	.....	
83,040	80,000	.543	.256	
85,116	82,000	.59	.....	
87,192	84,000	.65	.....	
89,268	86,000	.73	.....	
91,344	88,000	.79	.....	
93,420	90,000	.87	.....	
95,496	92,000	1.13	.....	
103,800	100,000	1.42	.....	
126,000	121,400	.....	.....	Ultimate strength.

Rail not fractured.

Permanent deflection, 19 degrees.

RAIL No. 97.
THIRD SPECIMEN.

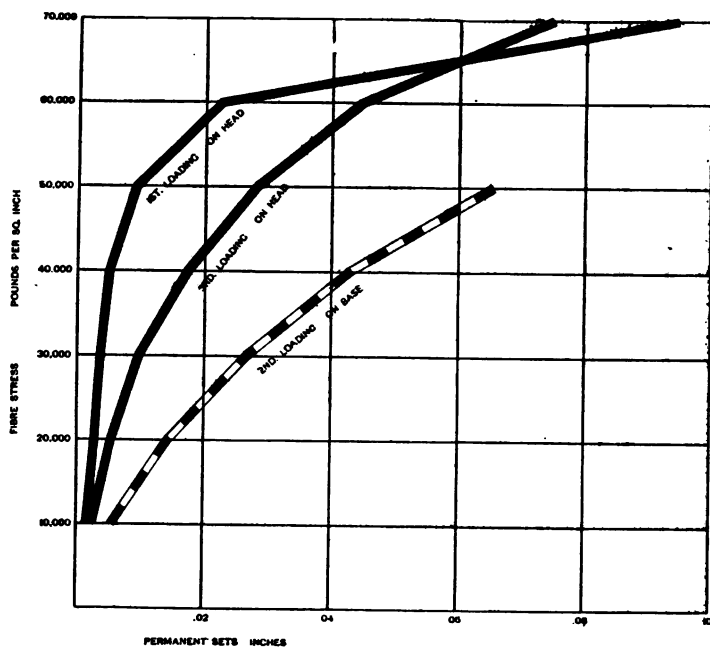
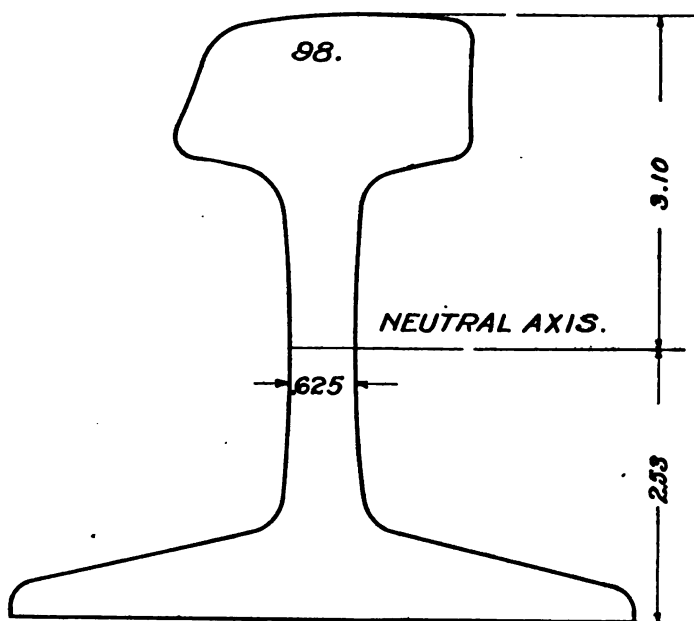


Diagram showing the effects of overloading and loading in reversed directions in the development of permanent sets.



$$I = 39.30$$

No. 765.

STEEL RAIL No. 98.

First specimen.

Section of old rail, branded, "Carnegie, 1902 E T 11111."

Height, 5".63.

Width of base, 5".75.

Weight per yard, 95.4 pounds.

Ends supported 54" apart.

Loaded on head at the middle.

Additional marks, No. 4, P. F. C.

Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
930	1,000	0.	0.	Initial load.
9,390	10,000	.035	.001	
18,780	20,000	.069	.001	
28,170	30,000	.103	.002	
32,865	35,000	.120	.....	
37,560	40,000	.138	.002	
42,255	45,000	.156	.....	
46,950	50,000	.174	.005	
51,645	55,000	.194	.008	
52,584	56,000	.198	.....	
54,462	58,000	.206	.....	
56,340	60,000	.215	.013	
58,218	62,000	.225		Elastic limit, approximate.
60,096	64,000	.233	.....	
61,974	66,000	.243	.....	
63,852	68,000	.254	.....	
65,730	70,000	.267	.026	
67,608	72,000	.283	.....	
69,486	74,000	.310	.....	
71,364	76,000	.335	.....	
73,242	78,000	.374	.....	
75,120	80,000	.432	.155	
79,815	85,000	.55		Ultimate strength.
84,510	90,000	.74	.....	
89,205	95,000	.94	.....	
93,900	100,000	1.16	.....	
118,400	126,100	4.40	.....	

Rail not fractured.

Permanent deflection, 18 degrees.

No. 766.

STEEL RAIL No. 98.

Second specimen.

Section of old rail, branded, "Carnegie, 1902 E T 11111."

Height, 5".63.

Width of base, 5".75.

Weight per yard, 95.1 pounds.

Ends supported 54" apart.

Loaded on base at the middle.

Additional marks, No. 4, P. F. C.

Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
839	1,000	0.	0.	Initial load.
9,390	10,000	.037	.002	
18,780	20,000	.066	.002	
28,170	30,000	.100	.003	
32,865	35,000	.116	.....	
37,560	40,000	.134	.004	
42,255	45,000	.151	.....	
46,950	50,000	.171	.008	
51,645	55,000	.192	.013	
52,584	56,000	.197	.....	
54,462	58,000	.207	.....	
56,340	60,000	.217	.021	
58,218	62,000	.229	.....	
60,096	64,000	.240	.....	
61,974	66,000	.252		Elastic limit, approximate.
63,852	68,000	.267	.....	
65,730	70,000	.287	.055	
67,608	72,000	.298	.....	
69,486	74,000	.312	.....	
71,364	76,000	.363	.....	
73,242	78,000	.409	.....	
75,120	80,000	.462	.192	
79,815	85,000	.59	.....	
84,510	90,000	.77	.....	
89,205	95,000	.98		Ultimate strength.
93,900	100,000	1.23	.....	
111,000	118,200	.....	.....	

Rail fractured.

Appearance, granular, radiating from inside edge of running surface of the head.

Permanent deflection, 8 degrees.

No. 767.

STEEL RAIL No. 98.

Third specimen.

Section of old rail, branded, "Carnegie 1902 E T 11111."

Height, 5".63.

Width of base, 5".75.

Weight per yard, 96.0 pounds.

Ends supported 54" apart.

Loaded on base at the middle.

Additional marks, No. 4, P. F. C.

Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
939	1,000	0.	0.	Initial load.
9,390	10,000	.033	.001	
18,780	20,000	.068	.001	
28,170	30,000	.104	.002	
37,560	40,000	.139	.003	
46,950	50,000	.176	.006	
56,340	60,000	.221	.015	
61,035	65,000	.250	.....	
65,730	70,000	.286	.044	
70,425	75,000	.337	.....	
75,120	80,000	.431	.156	Ultimate strength.
107,600	114,600	.....	.....	

Rail fractured.

Appearance, granular, radiating from the center of the head.

Permanent deflection, 6 degrees.



RAIL NO. 98.

3D. SPECIMEN.

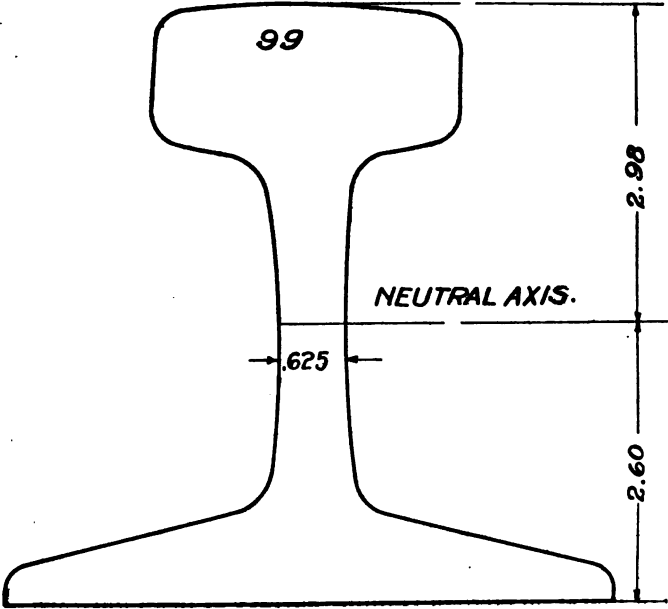
APPEARANCE OF FRACTURED SURFACE CENTER OF RADIATION NEAR CENTER OF HEAD.



RAIL NO. 98.

3D. SPECIMEN.

CROSS-SECTION OF HEAD. FRACTURED SURFACE, POLISHED AND ETCHED,
WELL DEFINED SPOT MARKING CENTER OF RADIATION OF FRACTURE.



I-40.39

No. 768.

STEEL RAIL No. 99.

First specimen.

Section of old rail, branded, "Carnegie 1902 E T 11111."

Height, 5".58.

Width of base, 5".75.

Weight per yard, 96.6 pounds.

Ends supported 54" apart.

Loaded on head at the middle.

Additional marks, No. 5, P. F. C.

Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	
1,004	1,000	0.	0.	Initial load.
10,040	10,000	.048	.008	
20,080	20,000	.084	.009	
30,120	30,000	.119	.011	
35,140	35,000	.137	.....	
40,160	40,000	.154	.013	
45,180	45,000	.173	.....	
50,200	50,000	.192	.016	
52,208	52,000	.200	.....	
54,216	54,000	.208	.....	
56,224	56,000	.217		Elastic limit, approximate.
58,232	58,000	.226	.....	
60,240	60,000	.236	.027	
62,248	62,000	.246	.....	
64,256	64,000	.261	.....	
66,264	66,000	.281	.051	Snapping sound.
70,280	70,000	.35	.....	
75,300	75,000	.51	.....	
80,320	80,000	.60	.....	
85,340	85,000	.92	.....	
90,360	90,000	1.19		Maximum load applied.
95,380	95,000	1.52	.....	
100,400	100,000	1.94	.....	
121,000	120,500	4.95	.....	

Rail not fractured.

Fins of metal on edge of running surface of head partially detached.

Permanent deflection, 21 degrees.



RAIL NO. 99.

CROSS SECTION. POLISHED AND ETCHED.

No. 769.

STEEL RAIL No. 99.

Second specimen.

Section of old rail, branded, "Carnegie 1902 E T 11111."

Height, 5".58.

Width of base, 5".75.

Weight per yard, 96.6 pounds.

Ends supported 54" apart.

Loaded on base at the middle.

Additional marks, "No. 5, P. F. C."

Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,004	1,000	0.	0.	Initial load.
16,040	10,000	.026	.001	
20,080	20,000	.064	.002	
30,120	30,000	.097	.002	
35,140	35,000	.115		
40,160	40,000	.132	.004	
45,180	45,000	.151		
50,200	50,000	.172	.010	
52,208	52,000	.181		
54,216	54,000	.190		
56,224	56,000	.200		
58,232	58,000	.210		Elastic limit, approximate.
60,240	60,000	.221	.025	
62,248	62,000	.232		
64,256	64,000	.249		
66,264	66,000	.267		
68,272	68,000	.286		
70,280	70,000	.317	.085	
75,300	75,000	.39		
80,320	80,000	.57		
85,340	85,000	.74		
90,360	90,000			Ultimate strength.

Rail fractured.

Appearance of fracture, granular, starting from the outside edge of the running surface where a heavy fin had been formed by wheel pressures in service.

Permanent deflection, 2½ degrees.

No. 770.

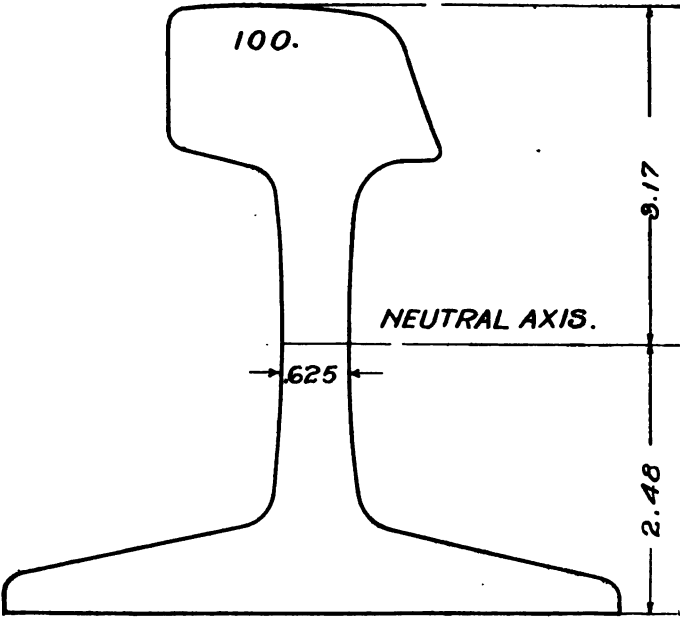
STEEL RAIL No. 99.

Third specimen, annealed at full red heat.
 Section of old rail, branded, "Carnegie 1902 E T 11111."
 Height, 5".58.
 Width of base, 5".75.
 Weight per yard, 96.3 pounds.
 Ends supported 54" apart.
 Loaded on base at the middle.
 Additional marks, "No. 5, P. F. C."

Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	
1,004	1,000	0.	0.	Initial load.
10,040	10,000	.040	.000	
20,080	20,000	.080	.001	
30,120	30,000	.114	.002	
35,140	35,000	.130		
40,160	40,000	.146	.002	
45,180	45,000	.162		
50,200	50,000	.178	.002	
52,208	52,000	.184		
54,216	54,000	.191		
56,224	56,000	.197		
58,232	58,000	.204		
60,240	60,000	.210	.004	Elastic limit, approximate.
62,248	62,000	.218		
64,256	64,000	.226		
66,264	66,000	.235		
68,272	68,000	.250		
70,280	70,000	.275	.043	
75,300	75,000	.55		
80,320	80,000	.78		
85,340	85,000	1.10		
90,360	90,000	1.46		
95,380	95,000	1.86		
100,400	100,000	2.31		Maximum load applied.
114,200	113,700	5.12		

Rail not fractured.

Permanent deflection, 22 degrees.



I- 37. 64

No. 771.

STEEL RAIL No. 100.

First specimen.

Section of old rail, branded, "Carnegie 1902 E T 11111."

Height, 5".65.

Width of base, 5".75.

Weight per yard, 92.1 pounds.

Ends supported 54" apart.

Loaded on head at the middle.

Additional marks, "No. 6, P. F. C."

Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
880	1,000	0.	0.	Initial load.
8,800	10,000	.041	.001	
17,600	20,000	.073	.002	
26,400	30,000	.106	.002	
30,800	35,000	.122		
35,200	40,000	.138	.004	
39,600	45,000	.155		
44,000	50,000	.172	.006	
45,760	52,000	.180		
47,520	54,000	.187		
49,280	56,000	.194		
51,040	58,000	.201		
52,800	60,000	.210	.013	
54,560	62,000	.219		
56,320	64,000	.227		
58,080	66,000	.235		Elastic limit, approximate.
59,840	68,000	.244		
61,600	70,000	.254	.025	
63,360	72,000	.264		
65,120	74,000	.274		
66,880	76,000	.287		
68,640	78,000	.303		
70,400	80,000	.325	.004	
74,800	85,000	.40		
79,200	90,000	.53		
83,600	95,000	.68		Ultimate strength.
88,000	100,000	.83		
113,100	128,500	.....		

Rail not fractured.

Permanent deflection, when test was discontinued, 12 degrees.

No. 772.

STEEL RAIL No. 100.

Second specimen. Annealed at full red heat.

Section of old rail, branded, "Carnegie 1902 E T 11111."

Height, 5".65.

Width of base, 5".75.

Weight per yard, 91.8 pounds.

Ends supported 54" apart.

Loaded on base at the middle.

Additional marks, "No. 6, P. F. C."

Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	
880	1,000	0.	0.	Initial load.
8,800	10,000	.037	.002	
17,600	20,000	.074	.002	
26,400	30,000	.105	.003	
30,800	35,000	.120	.....	
35,200	40,000	.135	.004	
39,600	45,000	.150	.....	
44,000	50,000	.165	.004	
45,760	52,000	.170	.....	
47,520	54,000	.176	.....	
49,280	56,000	.182	.....	
51,040	58,000	.188	.....	
52,800	60,000	.194	.004	
54,560	62,000	.200		Elastic limit, approximate.
56,320	64,000	.206	.....	
58,080	66,000	.212	.....	
59,840	68,000	.218	.....	
61,600	70,000	.225	.007	
63,360	72,000	.233	.....	
65,120	74,000	.241	.....	
66,880	76,000	.252	.....	
68,640	78,000	.279	.....	
70,400	80,000	.328	.062	
74,800	85,000	.48		Ultimate strength.
79,200	90,000	.66	.....	
83,600	95,000	.87	.....	
88,000	100,000	1.13	.....	
92,400	105,000	1.40	.....	
96,800	110,000	1.72		
114,600	130,200	4.01		

Rail not fractured.

After passing the maximum stress, deflections increased under gradually diminishing loads, rail bending sidewise in part.

Permanent deflection, 19½ degrees.

No. 773.

STEEL RAIL No. 100.

Third specimen.

Section of old rail, branded, "Carnegie 1902 E T 11111."

Height, 5".65.

Width of base, 5".75.

Weight per yard, 90.9 pounds.

Ends supported 54" apart.

Loaded on base at the middle.

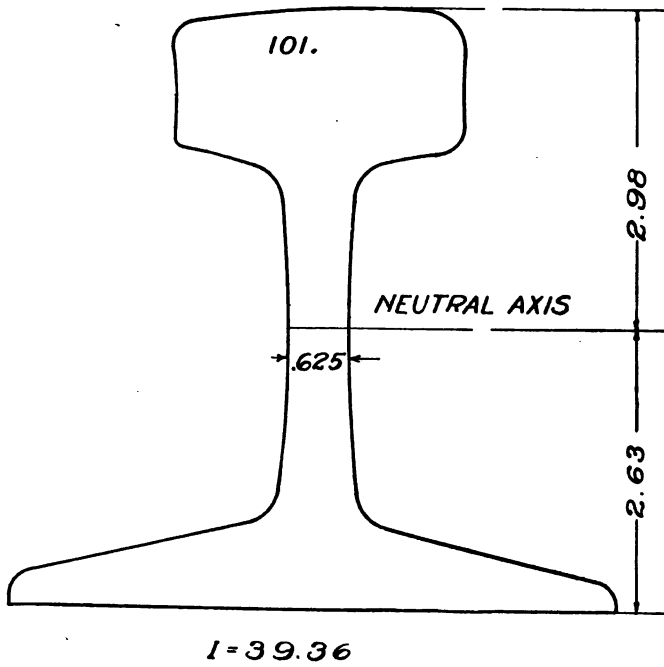
Additional marks, "No. 6, P. F. C."

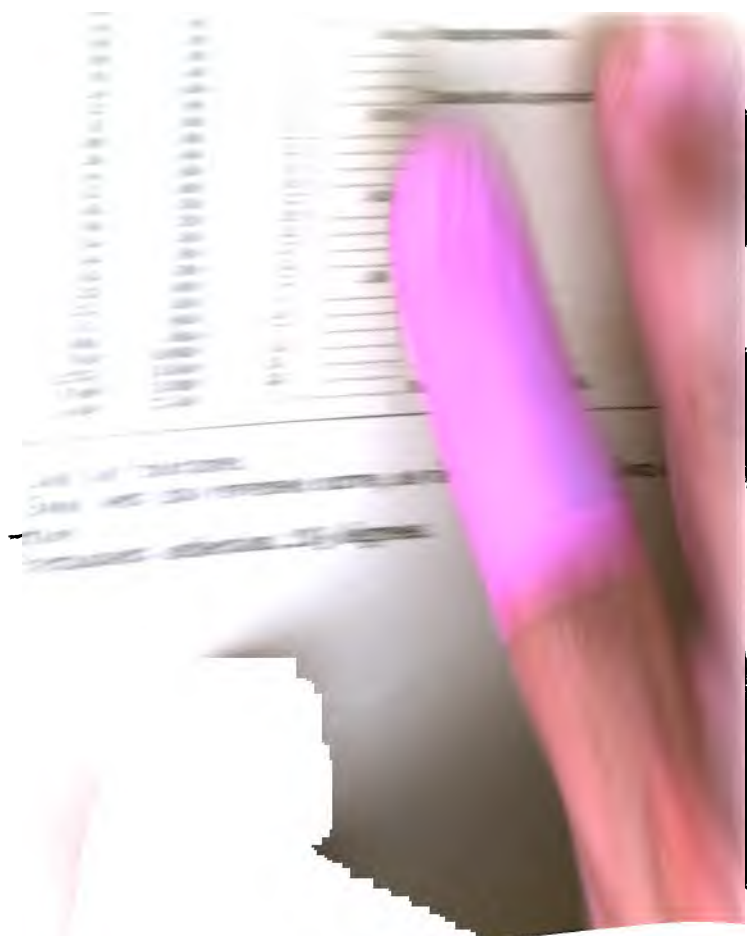
Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inches</i>	<i>Inch.</i>	
880	1,000	0.	0.	Initial load.
8,800	10,000	.039	.001	
17,600	20,000	.074	.001	
26,400	30,000	.104	.002	
30,800	35,000	.119	.....	
35,200	40,000	.133	.002	
39,600	45,000	.148	.....	
44,000	50,000	.164	.003	
45,760	52,000	.170	.....	
47,520	54,000	.176	.....	
49,280	56,000	.182		Elastic limit, approximate.
51,040	58,000	.188	.....	
52,800	60,000	.195	.006	
54,560	62,000	.202	.....	
56,320	64,000	.209	.....	
58,080	66,000	.216	.....	
59,840	68,000	.223	.....	
61,600	70,000	.230	.012	
63,360	72,000	.240	.....	
65,120	74,000	.249	.....	
66,880	76,000	.261		Ultimate strength.
68,640	78,000	.272	.....	
70,400	80,000	.288	.039	
74,800	85,000	.33	.....	
79,200	90,000	.44	.....	
83,600	95,000	.56	.....	
88,000	100,000	.71	.....	
92,400	105,000	.90	.....	
96,800	110,000	1.06	.....	
103,800	118,000	.....	.....	

Rail fractured.

Appearance of fracture, granular, starting from fin at lower side of head where flange wear and flow of metal occurred.

Permanent deflection, $3\frac{1}{2}$ degrees.







MAIL NO. 101.

SPECIMEN.

FACTURED SURFACE.

No. 774.

STEEL RAIL No. 101.

First specimen.

Section of old rail, branded, "Carnegie 1902 E T 11111."

Height, 5".61.

Width of base, 5".75.

Weight per yard, 95.1 pounds.

Ends supported 54" apart.

Loaded on head at the middle.

Additional marks, "No. 7, P. F. C."

Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	
979	1,000	0.	0.	Initial load.
9,790	10,000	.035	.002	
19,580	20,000	.069	.003	
29,370	30,000	.103	.004	
34,265	35,000	.120	.....	
39,160	40,000	.137	.006	
44,055	45,000	.155	.....	
48,950	50,000	.174	.009	Snapping sounds.
50,908	52,000	.181	.....	
52,866	54,000	.189	.....	
54,824	56,000	.197	.....	
56,782	58,000	.206	.....	
58,740	60,000	.216	.019	Elastic limit, approximate.
60,698	62,000	.221	.....	
62,656	64,000	.236	.....	
64,614	66,000	.248	.....	
66,572	68,000	.260	.....	
68,530	70,000	.273	.042	
70,488	72,000	.288	.....	
72,446	74,000	.301	.....	
74,404	76,000	.317	.....	
76,362	78,000	.341	.....	
78,320	80,000	.371	.104	
83,215	85,000	.44	.....	
88,110	90,000	.59	.....	
93,005	95,000	.77	.....	
97,900	100,000	.93	.....	
102,795	105,000	1.16	.....	
107,690	110,000	1.43	.....	
134,500	137,400	.....	.....	Maximum load applied.

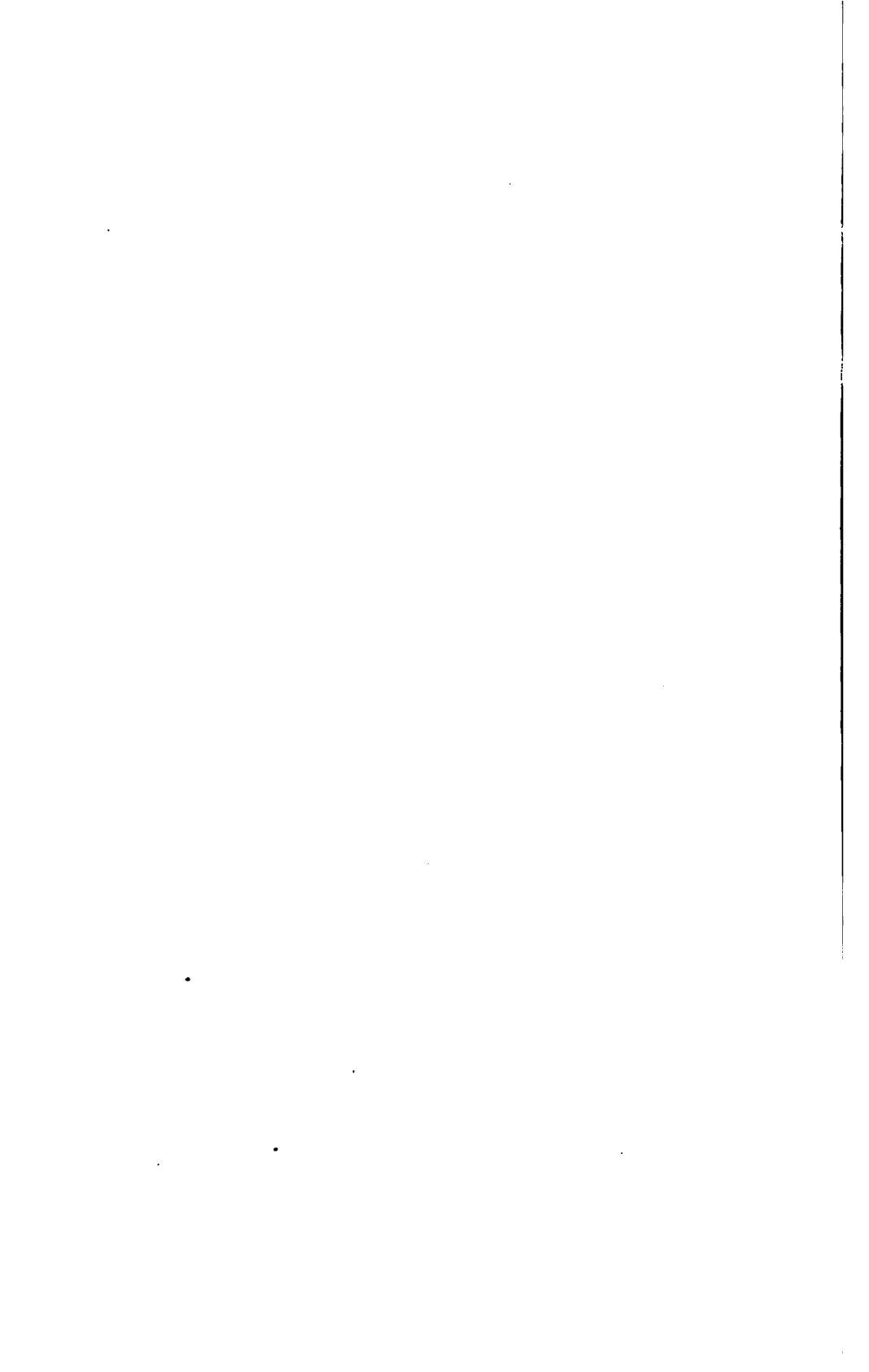
Rail not fractured.

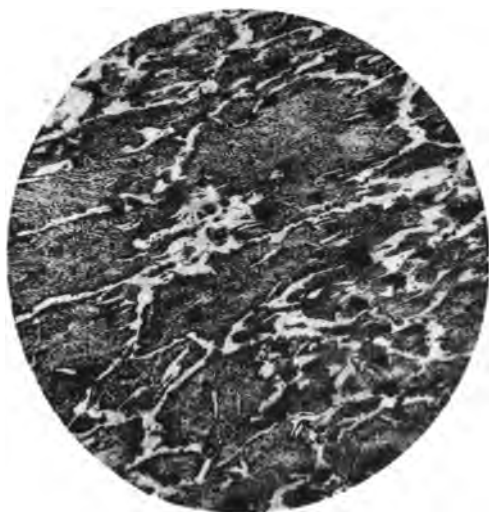
Head bent into reversed curve, as viewed looking down on running surface.

Permanent deflection, $21\frac{1}{2}$ degrees.



RAIL NO. 101.
2D. SPECIMEN.
APPEARANCE OF FRACTURED SURFACE.





RAIL NO. 101.

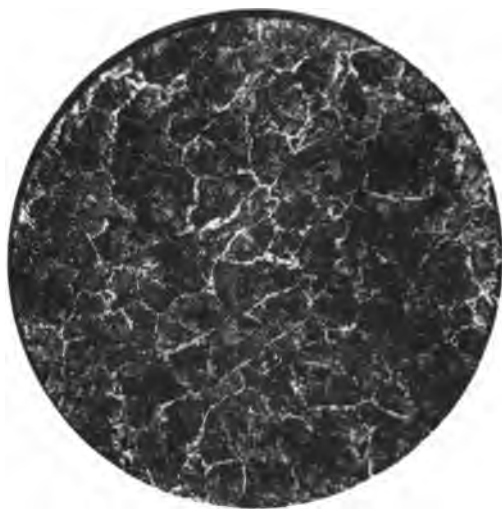
PHOTOMICROGRAPH OF HEAD AT JUNCTION OF NORMAL STRUCTURE
AND PART AFFECTED BY WHEEL PRESSURES.
MAGNIFICATION 110 DIAMETERS.



RAIL NO. 101.

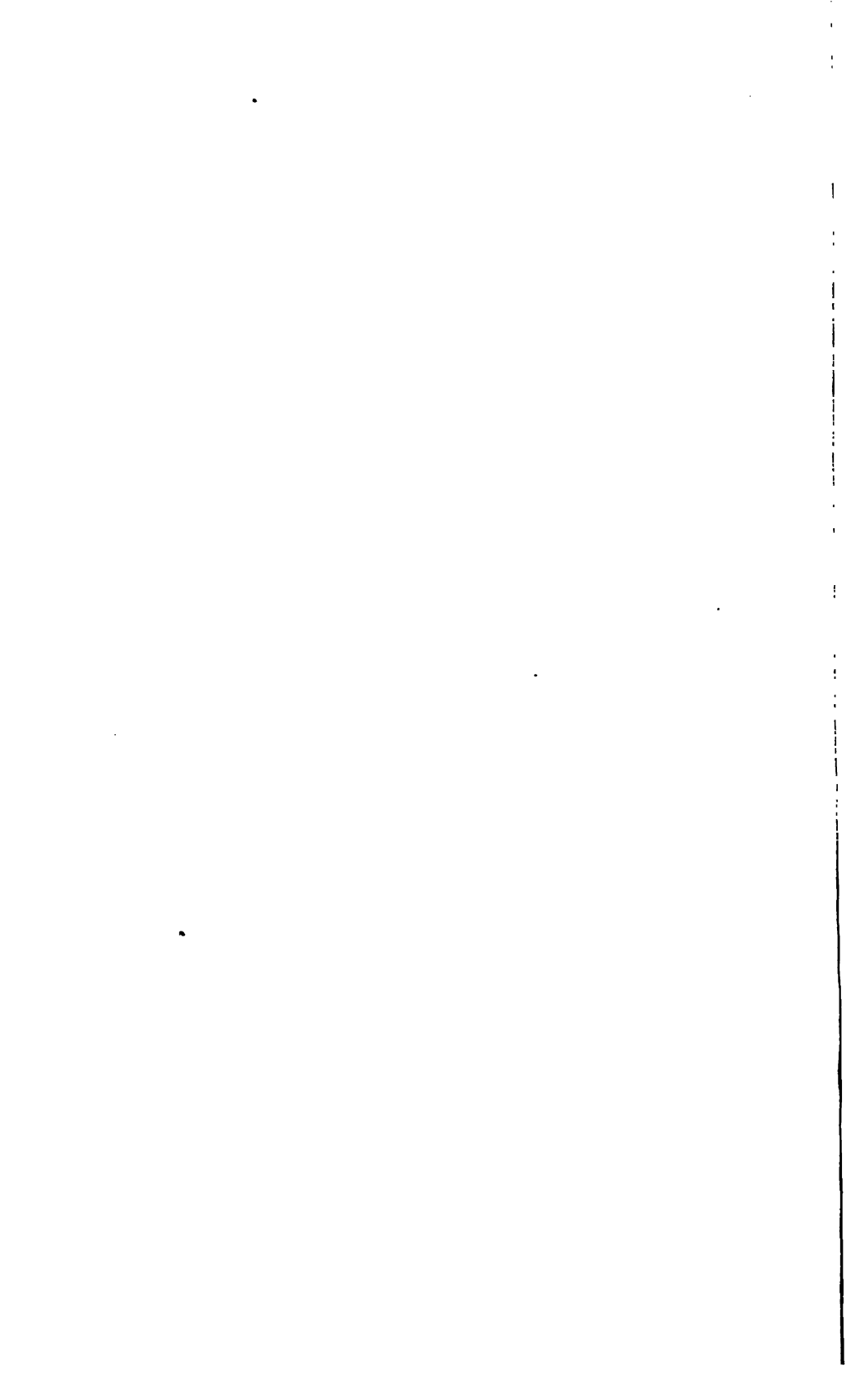
PHOTOMICROGRAPH OF FIN ON EDGE OF HEAD, SHOWING DISTORTION
OF METAL CAUSED BY WHEEL PRESSURES.

MAGNIFICATION 110 DIAMETERS.



RAIL NO. 101.

PHOTOMICROGRAPH OF HEAD SHOWING STRUCTURE AFTER ANNEALING AT YELLOW
HEAT. THE SAME STRUCTURE NOW PERTAINS TO THE METAL WHICH
HAD BEEN AFFECTED BY THE WHEEL PRESSURES
AS TO OTHER PARTS OF THE HEAD.
MAGNIFICATION 110 DIAMETERS.



No. 775.

STEEL RAIL No. 101.

Second specimen.

Section of old rail, branded, "Carnegie 1902 E T 11111."

Height, 5".61.

Width of base, 5".75.

Weight per yard, 96.0 pounds.

Ends supported 54" apart.

Loaded on base at the middle.

Additional marks, "No. 7, P. F. C."

Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	
979	1,000	0.	0.	Initial load.
9,790	10,000	.032	.001	
19,580	20,000	.066	.001	
29,370	30,000	.101	.002	
34,265	35,000	.118	.....	
39,160	40,000	.135	.002	
44,055	45,000	.152	.....	
48,950	50,000	.169	.003	
50,908	52,000	.176	.....	
52,866	54,000	.184	.....	
54,824	56,000	.191	.....	
56,782	58,000	.198	.....	
58,740	60,000	.206	.006	
60,698	62,000	.213	.....	
62,656	64,000	.226		Elastic limit, approximate.
64,614	66,000	.230	.....	
66,572	68,000	.239	.....	
68,530	70,000	.251	.019	
70,488	72,000	.263	.....	
72,446	74,000	.277	.....	
74,404	76,000	.295	.....	
76,362	78,000	.319	.....	
78,320	80,000	.346	.080	
83,215	85,000	.43	.....	
88,110	90,000	.59		Ultimate strength.
93,005	95,000	.73	.....	
97,900	100,000	.95	.....	
107,690	110,000	1.46	.....	
112,600	115,000			

Rail fractured.

Appearance of fracture, granular, radiating from inner corner of running surface of the head.

Permanent deflection, 4 degrees.

No. 776.

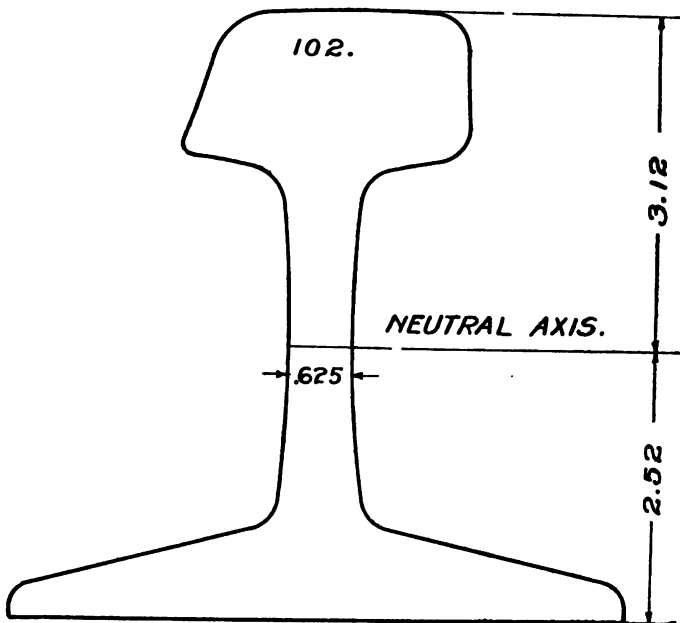
STEEL RAIL No. 101.

Third specimen. Annealed at full red heat.
 Section of old rail, branded, "Carnegie 1902 E T 11111."
 Height, 5".61.
 Width of base, 5".75.
 Weight per yard, 94.8 pounds.
 Ends supported 54" apart.
 Loaded on base at the middle.
 Additional marks, "No. 7, P. F. C."

Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	
979	1,000	0.	0.	Initial load.
9,790	10,000	.047	.000	
19,580	20,000	.082	.000	
29,370	30,000	.111	.001	
34,265	35,000	.131		
39,160	40,000	.147	.001	
44,055	45,000	.162		
48,950	50,000	.177	.002	
50,908	52,000	.184		
52,866	54,000	.190		
54,824	56,000	.196		
56,782	58,000	.202		
58,740	60,000	.208	.003	
60,698	62,000	.216		
62,656	64,000	.222		Elastic limit, approximate. Scale starts off.
64,614	66,000	.229		
66,572	68,000	.236		
68,530	70,000	.245	.010	
70,488	72,000	.255		
72,446	74,000	.267		
74,404	76,000	.287		
76,362	78,000	.346		
78,320	80,000	.445	.183	
83,215	85,000	.64		
88,110	90,000	.87		Ultimate strength.
93,005	95,000	1.11		
97,900	100,000	1.42		
102,795	105,000	1.75		
107,690	110,000	2.13		
122,000	124,600	4.50		

Rail not fractured.

Permanent deflection, when test was discontinued, $21\frac{1}{2}$ degrees.



$I = 39.34$

No. 780.

STEEL RAIL No. 102.

First specimen.

Section of old rail, branded, "Carnegie 1902 E T 11111."

Height, 5".64.

Width of base, 5".75.

Weight per yard, 93.0 pounds.

Ends supported 54" apart.

Loaded on head at the middle.

Additional marks, "No. 8, P. F. C."

Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	
334	1,000	0.	0.	Initial load.
9,340	10,000	.043	.002	
18,680	20,000	.080	.002	
28,020	30,000	.112	.002	
32,690	35,000	.127	.....	
37,360	40,000	.143	.003	
42,030	45,000	.158	.....	
46,700	50,000	.175	.005	
48,568	52,000	.182	.....	
50,436	54,000	.189	.....	
52,304	56,000	.196	.....	
54,172	58,000	.203	.....	
56,040	60,000	.211	.010	
57,908	62,000	.219	.....	
59,776	64,000	.226	.....	
61,644	66,000	.234	.....	Elastic limit, approximate.
63,512	68,000	.243	.....	
65,380	70,000	.252	.021	
67,248	72,000	.261	.....	
69,116	74,000	.271	.....	
70,984	76,000	.282	.....	
72,852	78,000	.295	.....	
74,720	80,000	.308	.046	
76,588	85,000	.37	.....	
78,456	90,000	.45	.....	
80,324	95,000	.58	.....	Ultimate resistance.
82,192	100,000	.74	.....	
84,060	105,000	.93	.....	
85,928	110,000	1.16	.....	
87,796	115,000	1.39	.....	
89,664	120,000	1.69	.....	
91,532	125,000	2.05	.....	
93,400	130,000	2.45	.....	
95,268	135,000	2.85	.....	
97,136	140,000	3.25	.....	
99,004	145,000	3.65	.....	
100,872	150,000	4.05	.....	
102,740	155,000	4.45	.....	
104,608	160,000	4.85	.....	
106,476	165,000	5.25	.....	
108,344	170,000	5.65	.....	
110,212	175,000	6.05	.....	
112,080	180,000	6.45	.....	
113,948	185,000	6.85	.....	
115,816	190,000	7.25	.....	
117,684	195,000	7.65	.....	
119,552	200,000	8.05	.....	
121,420	205,000	8.45	.....	
123,288	210,000	8.85	.....	
125,156	215,000	9.25	.....	
127,024	220,000	9.65	.....	
128,892	225,000	10.05	.....	
130,760	230,000	10.45	.....	
132,628	235,000	10.85	.....	
134,496	240,000	11.25	.....	
136,364	245,000	11.65	.....	
138,232	250,000	12.05	.....	
140,100	255,000	12.45	.....	
141,968	260,000	12.85	.....	
143,836	265,000	13.25	.....	
145,704	270,000	13.65	.....	
147,572	275,000	14.05	.....	
149,440	280,000	14.45	.....	
151,308	285,000	14.85	.....	
153,176	290,000	15.25	.....	
155,044	295,000	15.65	.....	
156,912	300,000	16.05	.....	
158,780	305,000	16.45	.....	
160,648	310,000	16.85	.....	
162,516	315,000	17.25	.....	
164,384	320,000	17.65	.....	
166,252	325,000	18.05	.....	
168,120	330,000	18.45	.....	
170,000	335,000	18.85	.....	
171,880	340,000	19.25	.....	
173,760	345,000	19.65	.....	
175,640	350,000	20.05	.....	
177,520	355,000	20.45	.....	
179,400	360,000	20.85	.....	
181,280	365,000	21.25	.....	
183,160	370,000	21.65	.....	
185,040	375,000	22.05	.....	
186,920	380,000	22.45	.....	
188,800	385,000	22.85	.....	
190,680	390,000	23.25	.....	
192,560	395,000	23.65	.....	
194,440	400,000	24.05	.....	
196,320	405,000	24.45	.....	
198,200	410,000	24.85	.....	
200,080	415,000	25.25	.....	
201,960	420,000	25.65	.....	
203,840	425,000	26.05	.....	
205,720	430,000	26.45	.....	
207,600	435,000	26.85	.....	
209,480	440,000	27.25	.....	
211,360	445,000	27.65	.....	
213,240	450,000	28.05	.....	
215,120	455,000	28.45	.....	
217,000	460,000	28.85	.....	
218,880	465,000	29.25	.....	
220,760	470,000	29.65	.....	
222,640	475,000	30.05	.....	
224,520	480,000	30.45	.....	
226,400	485,000	30.85	.....	
228,280	490,000	31.25	.....	
230,160	495,000	31.65	.....	
232,040	500,000	32.05	.....	
233,920	505,000	32.45	.....	
235,800	510,000	32.85	.....	
237,680	515,000	33.25	.....	
239,560	520,000	33.65	.....	
241,440	525,000	34.05	.....	
243,320	530,000	34.45	.....	
245,200	535,000	34.85	.....	
247,080	540,000	35.25	.....	
248,960	545,000	35.65	.....	
250,840	550,000	36.05	.....	
252,720	555,000	36.45	.....	
254,600	560,000	36.85	.....	
256,480	565,000	37.25	.....	
258,360	570,000	37.65	.....	
260,240	575,000	38.05	.....	
262,120	580,000	38.45	.....	
264,000	585,000	38.85	.....	
265,880	590,000	39.25	.....	
267,760	595,000	39.65	.....	
269,640	600,000	40.05	.....	
271,520	605,000	40.45	.....	
273,400	610,000	40.85	.....	
275,280	615,000	41.25	.....	
277,160	620,000	41.65	.....	
279,040	625,000	42.05	.....	
280,920	630,000	42.45	.....	
282,800	635,000	42.85	.....	
284,680	640,000	43.25	.....	
286,560	645,000	43.65	.....	
288,440	650,000	44.05	.....	
290,320	655,000	44.45	.....	
292,200	660,000	44.85	.....	
294,080	665,000	45.25	.....	
295,960	670,000	45.65	.....	
297,840	675,000	46.05	.....	
299,720	680,000	46.45	.....	
301,600	685,000	46.85	.....	
303,480	690,000	47.25	.....	
305,360	695,000	47.65	.....	
307,240	700,000	48.05	.....	
309,120	705,000	48.45	.....	
311,000	710,000	48.85	.....	
312,880	715,000	49.25	.....	
314,760	720,000	49.65	.....	
316,640	725,000	50.05	.....	
318,520	730,000	50.45	.....	
320,400	735,000	50.85	.....	
322,280	740,000	51.25	.....	
324,160	745,000	51.65	.....	
326,040	750,000	52.05	.....	
327,920	755,000	52.45	.....	
329,800	760,000	52.85	.....	
331,680	765,000	53.25	.....	
333,560	770,000	53.65	.....	
335,440	775,000	54.05	.....	
337,320	780,000	54.45	.....	
339,200	785,000	54.85	.....	
341,080	790,000	55.25	.....	
342,960	795,000	55.65	.....	
344,840	800,000	56.05	.....	
346,720	805,000	56.45	.....	
348,600	810,000	56.85	.....	
350,480	815,000	57.25	.....	
352,360	820,000	57.65	.....	
354,240	825,000	58.05	.....	
356,120	830,000	58.45	.....	
358,000	835,000	58.85	.....	
359,880	840,000	59.25	.....	
361,760	845,000	59.65	.....	
363,640	850,000	60.05	.....	
365,520	855,000	60.45	.....	
367,400	860,000	60.85	.....	
369,280	865,000	61.25	.....	
371,160	870,000	61.65	.....	
373,040	875,000	62.05	.....	
374,920	880,000	62.45	.....	
376,800	885,000	62.85	.....	
378,680	890,000	63.25	.....	
380,560	895,000	63.65	.....	
382,440	900,000	64.05	.....	
384,320	905,000	64.45	.....	
386,200	910,000	64.85	.....	
388,080	915,000	65.25	.....	
390,000	920,000	65.65	.....	
391,880	925,000	66.05	.....	
393,760	930,000	66.45	.....	
395,640	935,000	66.85	.....	
397,520	940,000	67.25	.....	
399,400	945,000	67.65	.....	
401,280	950,000	68.05	.....	
403,160	955,000	68.45	.....	
405,040	960,000	68.85	.....	
406,920	965,000	69.25	.....	
408,800	970,000	69.65	.....	
410,680	975,000	70.05	.....	
412,560	980,000	70.45	.....	
414,440	985,000	70.85	.....	
416,320	990,000	71.25	.....	
418,200	995,000	71.65	.....	
420,080	100,000	72.05	.....	
421,960	100,000	72.45	.....	
423,840	100,000	72.85	.....	
425,720	100,000	73.25	.....	
427,600	100,000	73.65	.....	
429,480	100,000	74.05	.....	
431,360	100,000	74.45	.....	
433,240	100,000	74.85	.....	
435,120	100,000	75.25	.....	
437,000	100,000	75.65	.....	
438,880	100,000	76.05	.....	
440,760	100,000	76.45	.....	
442,640	100,000	76.85	.....	
444,520	100,000	77.25	.....	
446,400	100,000	77.65	.....	
448,280	100,000	78.05	.....	
450,160	100,000	78.45	.....	
452,040	100,000	78.85	.....	
453,920	100,000	79.25	.....	
455,800	100,000	79.65	.....	
457,680	100,000	80.05	.....	
459,560	100,000	80.45	.....	
461,440	100,000	80.85	.....	
463,320	100,000	81.25	.....	
465,200	100,000	81.65	.....	
467,080	100,000	82.05	.....	
468,960	100,000	82.45	.....	
470,840	100,000	82.85	.....	

No. 781.

STEEL RAIL No. 102.

Second specimen.

Section of old rail, branded, "Carnegie 1902 E T 11111."

Height, 5".64.

Width of base, 5".75.

Weight per yard, 93.0 pounds.

Ends supported 54" apart.

Loaded on base at the middle.

Additional marks, "No. 8, P. F. C."

Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	
934	1,000	0.	0.	Initial load.
9,340	10,000	.039	.001	
18,680	20,000	.076	.002	
28,020	30,000	.111	.002	
32,660	35,000	.122		
37,360	40,000	.137	.002	
42,030	45,000	.152		
46,700	50,000	.167	.003	
48,568	52,000	.173		
50,436	54,000	.180		
52,304	56,000	.186		
54,172	58,000	.192		
56,040	60,000	.199	.004	
57,908	62,000	.205		
59,776	64,000	.212		
61,644	66,000	.218		
63,512	68,000	.226		Elastic limit, approximate.
65,380	70,000	.233	.008	
67,248	72,000	.242		
69,116	74,000	.249		
70,984	76,000	.259		
72,852	78,000	.270		
74,720	80,000	.284	.029	
79,390	85,000	.33		
84,060	90,000	.43		
88,730	95,000	.57		
93,400	100,000	.74		
98,070	105,000	.92		
102,740	110,000	1.14		
107,410	115,000	1.37		
112,080	120,000	1.69		
119,800	128,300			Ultimate strength.

Rail fractured.

Appearance of fracture, granular, radiating from inner edge of running surface of the head.

Permanent deflection, $6\frac{1}{2}$ degrees.

No. 782.

STEEL RAIL No. 102.

Third specimen.

Section of old rail, branded, "Carnegie 1902 E T 11111."

Height, 5".64.

Width of base, 5".75.

Weight per yard, 92.7 pounds.

Ends supported 54" apart.

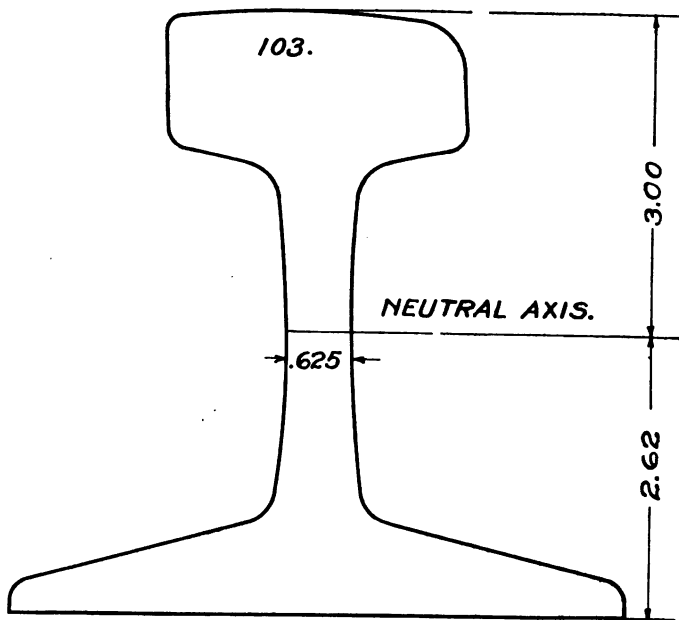
Loaded on head at the middle.

Additional marks, "No. 8, P. F. C."

Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	
934	1,000	0.	0.	Initial load.
9,340	10,000	.050	.002	
18,680	20,000	.089	.005	
28,020	30,000	.122		
37,360	40,000	.154	.006	
46,700	50,000	.185	.008	
48,568	52,000	.192		
50,436	54,000	.199		
52,304	56,000	.205		
54,172	58,000	.212		
56,040	60,000	.218	.011	
57,908	62,000	.226		
59,776	64,000	.233		
61,644	66,000	.241		
63,512	68,000	.248		Elastic limit, approximate.
65,380	70,000	.257	.020	
67,248	72,000	.266		
69,116	74,000	.275		
70,984	76,000	.285		
72,852	78,000	.296		
74,720	80,000	.308	.040	
79,390	85,000	.38		
84,060	90,000	.48		
88,730	95,000	.64		
93,400	100,000	.80		
102,740	110,000	1.24		
112,080	120,000	1.81		
122,300	130,900	3.00		Ultimate strength.

Rail not fractured.

Permanent deflection when test was discontinued, 11 degrees.



$$I = 41.14$$

No. 783.

STEEL RAIL No. 103.

First specimen.

Section of old rail, branded, "Carnegie 1902 E T 11111."

Height, 5".62.

Width of base, 5".75.

Weight per yard, 96.3 pounds.

Ends supported 54" apart.

Loaded on head at the middle.

Additional marks, "No. 9, P. F. C., S. R. No. 3, T. R."

Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	
1,016	1,000	0.	0.	Initial load.
10,160	10,000	.053	.005	
20,320	20,000	.098	.009	
30,480	30,000	.131	.010	
35,560	35,000	.148		
40,640	40,000	.164	.012	
45,720	45,000	.181		
50,800	50,000	.198	.013	
52,832	52,000	.204		
54,864	54,000	.211		
56,896	56,000	.217		
58,928	58,000	.224		
60,960	60,000	.230	.016	
62,992	62,000	.238		
65,024	64,000	.244		
67,056	66,000	.250		
69,088	68,000	.258		
71,120	70,000	.263	.020	
73,152	72,000	.272		
75,184	74,000	.279		
77,216	76,000	.287		Elastic limit, approximate.
79,248	78,000	.295		
81,280	80,000	.303	.027	
83,312	82,000	.313		
85,344	84,000	.320		
87,376	86,000	.331		
89,408	88,000	.342		
91,440	90,000	.356	.049	
96,520	95,000	.44		
101,600	100,000	.51		
106,680	105,000	.61		Maximum load applied.
111,760	110,000	.74		
116,840	115,000	.89		
121,920	120,000	1.08		
150,000	147,600	2.00		

Rail not fractured.

Permanent deflection, when test was discontinued, 8 degrees.

No. 784.

STEEL RAIL NO. 103.

Second specimen.

Section of old rail, branded, "Carnegie 1902 E T 11111."

Height, 5".62.

Width of base, 5".75.

Weight per yard, 96.0 pounds.

Ends supported 54" apart.

Loaded on base at the middle.

Additional marks, "No. 9, P. F. C., S. R. No. 3, T. R."

Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	Initial load.
1,016	1,000	0.	0.	
10,160	10,000	.039	.001	
20,320	20,000	.076	.002	
30,480	30,000	.109	.003	
35,560	35,000	.125		
40,640	40,000	.141	.003	
45,720	45,000	.157		
50,800	50,000	.173	.004	
52,832	52,000	.179		
54,864	54,000	.186		
56,896	56,000	.192		
58,928	58,000	.198		
60,960	60,000	.205	.005	
62,992	62,000	.211		
65,024	64,000	.217		
67,056	66,000	.224		
69,088	68,000	.231		
71,120	70,000	.238	.007	
73,152	72,000	.246		
75,184	74,000	.252		
77,216	76,000	.260		Elastic limit, approximate.
79,248	78,000	.268		
81,280	80,000	.277	.015	
86,360	85,000	.29		
91,440	90,000	.33		
96,520	95,000	.39		
101,600	100,000	.48		
106,680	105,000	.58		
111,760	110,000	.71		
116,840	115,000	.85		
121,920	120,000	1.03		
127,000	125,000	1.22		
132,080	130,000	1.47		
135,400	133,300			Ultimate strength.

Rail fractured.

Appearance of fracture, granular, radiating from inner edge of running surface of the head.

Permanent deflection, $3\frac{1}{2}$ degrees.

No. 785.

STEEL RAIL No. 103.

Third specimen.

Section of old rail, branded, "Carnegie 1902 E T 11111."

Height, 5".62.

Width of base, 5".75.

Weight per yard, 95.7 pounds.

Ends supported 54" apart.

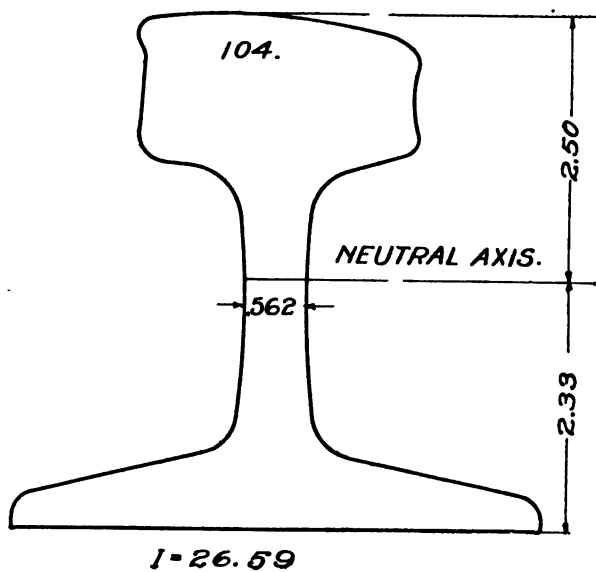
Loaded on head at the middle.

Additional marks, "No. 9, P. F. C., S. R. No. 3, T. R."

Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	
1,016	1,000	0.	0.	Initial load.
10,160	10,000	.049	.003	
20,320	20,000	.089	.004	
30,480	30,000	.123	.004	
35,560	35,000	.140	.....	
40,640	40,000	.156	.005	Rail rested under initial load 16 hours.
45,720	45,000	.171	.....	
50,800	50,000	.188	.005	
52,832	52,000	.198	.....	
54,864	54,000	.203	.....	
56,896	56,000	.209	.....	
58,928	58,000	.216	.....	
60,960	60,000	.223	.010	
62,992	62,000	.232	.....	
65,024	64,000	.239	.....	
67,056	66,000	.245	.....	
69,088	68,000	.254	.....	
71,120	70,000	.261	.016	
73,152	72,000	.270	.....	
75,184	74,000	.278	.....	
77,216	76,000	.286	.....	
79,248	78,000	.295	.....	Elastic limit, approximate.
81,280	80,000	.305	.029	
83,312	82,000	.315	.....	
85,344	84,000	.325	.....	
87,376	86,000	.337	.....	
89,408	88,000	.349	.....	
91,440	90,000	.363	.055	
93,472	92,000	.384	.....	
95,504	94,000	.407	.....	
97,536	96,000	.431	.....	
99,568	98,000	.470	.....	
101,600	100,000	.512	.064	
111,760	110,000	.65	.....	
116,840	115,000	.78	.....	
121,920	120,000	.95	.....	
127,000	125,000	1.14	.....	
132,080	130,000	1.35	.....	
150,000	147,600	2.36	.....	Maximum load applied.

Rail not fractured.

Permanent deflection when test was discontinued, $8\frac{1}{2}$ degrees.



No. 786.

STEEL RAIL No. 104.

First specimen.

Section of old rail, branded, "E T 92 11111111."

Height, 4".83.

Width of base, 4".875.

Weight per yard, 79.8 pounds.

Ends supported 54" apart.

Loaded on head at the middle.

Additional marks, "South rail (B) M.P. 190 × 2026 Ft. Deg. 2-08', E. 5.25."

Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
Pounds.	Pounds.	Inches.	Inch.	
788	1,000	0.	0.	Initial load.
7,880	10,000	.054	.004	
15,760	20,000	.103	.004	
23,640	30,000	.147	.004	
27,580	35,000	.168		
31,520	40,000	.189	.005	
35,460	45,000	.210		
39,400	50,000	.231	.006	
40,976	52,000	.240		
42,552	54,000	.248		
44,128	56,000	.256		
45,704	58,000	.265		
47,280	60,000	.274	.009	
48,856	62,000	.283		
50,432	64,000	.292		
52,008	66,000	.302		Elastic limit, approximate.
53,584	68,000	.311		
55,160	70,000	.321	.015	
56,736	72,000	.332		
58,312	74,000	.344		
59,888	76,000	.358		
61,464	78,000	.376		
63,040	80,000	.401	.053	
64,616	82,000	.421		
66,192	84,000	.455		
67,768	86,000	.490		
69,344	88,000	.530		
70,920	90,000	.578	.181	
74,860	95,000	.74		
78,800	100,000	.90		Maximum load applied.
82,740	105,000	1.12		
86,680	110,000	1.41		
90,620	115,000	1.73		
94,560	120,000	2.12		
108,100	137,200	5.20		

Rail not fractured.

Permanent deflection, when test was discontinued, 19½ degrees.

No. 787.

STEEL RAIL No. 104.

Second specimen.

Section of old rail, branded, "E T 92 11111111."

Height, 4".83.

Width of base, 4".875.

Weight per yard, 79.2 pounds.

Ends supported 54" apart.

Loaded on base at the middle.

Additional marks, "South rail ① M. P. 190 × 2026 feet. Deg. 2-08', E. 5.25."

Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
788	1,000	0.	0.	Initial load.
7,880	10,000	.046	.001	
15,760	20,000	.093	.001	
23,640	30,000	.134	.002	
27,580	35,000	.155	.....	
31,520	40,000	.175	.003	
35,460	45,000	.197	.....	
39,400	50,000	.218	.005	
40,976	52,000	.227	.....	
42,552	54,000	.236	.....	
44,128	56,000	.245	.....	
45,704	58,000	.254	.....	
47,280	60,000	.264	.010	
48,856	62,000	.272	.....	
50,432	64,000	.282	.....	Elastic limit, approximate.
52,008	66,000	.292	.....	
53,584	68,000	.303	.....	
55,160	70,000	.316	.022	
56,736	72,000	.329	.....	
58,312	74,000	.342	.....	
59,888	76,000	.358	.....	
61,464	78,000	.374	.....	
63,040	80,000	.396	.060	
64,616	82,000	.423	.....	
66,192	84,000	.454	.....	
67,768	86,000	.....	.....	Ultimate strength.

Rail fractured.

Appearance of fracture, granular, radiating from a blue-black spot ".08 deep by ".24 wide next running surface of head and near inner edge.

Permanent deflection, barely appreciable.

No. 788.

STEEL RAIL No. 104.

Third specimen.

Section of old rail, branded, "E T 92 11111111."

Height, 4".83.

Width of base, 4".875.

Weight per yard, 80.1 pounds.

Ends supported 54" apart.

Loaded on head at the middle.

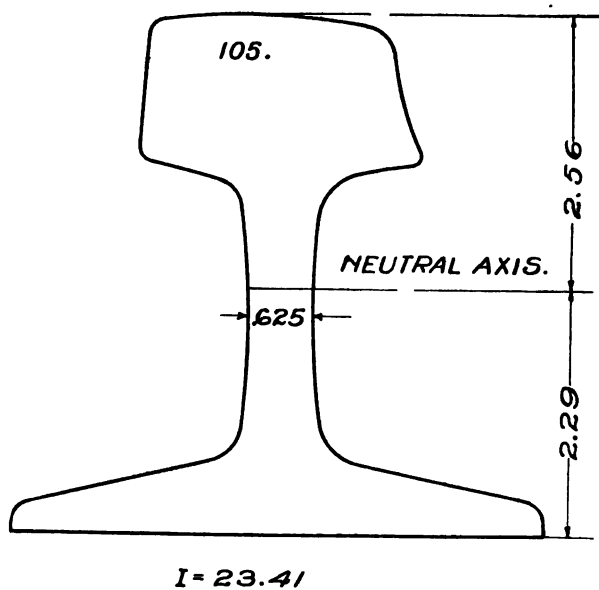
Additional marks, "South rail ☉ M. P. 190 × 2026 feet. Deg. 2-08', E. 5.25."

Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
788	1,000	0.	0.	Initial load.
7,880	10,000	.052	.000	
15,760	20,000	.090	.001	
23,640	30,000	.142	.001	
27,580	35,000	.163		
31,520	40,000	.184	.001	
35,460	45,000	.205		
39,400	50,000	.226	.002	
40,976	52,000	.234		
42,552	54,000	.242		
44,128	56,000	.253	.004	
45,704	58,000	.260		
47,280	60,000	.269	.006	
48,856	62,000	.278		
50,432	64,000	.288		Elastic limit, approximate.
52,008	66,000	.297		
53,584	68,000	.307		
55,160	70,000	.317	.014	
56,736	72,000	.329		
58,312	74,000	.340		
59,888	76,000	.356		
61,464	78,000	.373		
63,040	80,000	.397	.049	
64,616	82,000	.419		
66,192	84,000	.446		
67,768	86,000	.471		
69,344	88,000	.519		
70,920	90,000	.565	.166	
74,860	95,000	.75		Ultimate strength.
78,800	100,000	.93		
82,740	105,000	1.15		
86,680	110,000	1.43		
107,600	136,500			

Rail fractured.

Appearance of fracture, granular, radiating from an oblique crack in the base of the rail near the middle of its width and at the lower surface. The oblique crack was about $\frac{1}{2}$ " long by ".02 deep.

Permanent deflection, 17 degrees.



No. 789.

STEEL RAIL No. 105.

First specimen.

Section of old rail, branded, "E T 92 11111111."

Height, 4".85.

Width of base, 4".875.

Weight per yard, 78.6 pounds.

Ends supported 54" apart.

Loaded on head at the middle.

Additional marks, "North rail (A), M. P. 190 × 2041 Ft. Deg. 2-08', E. 5.25."

Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
678	1,000	0.	0.	Initial load.
6,780	10,000	.046	.001	
13,560	20,000	.090	.002	
20,340	30,000	.129	.003	
23,730	35,000	.148		
27,120	40,000	.166	.004	
30,510	45,000	.184		
33,900	50,000	.203	.004	
35,256	52,000	.210		
36,612	54,000	.217		
37,968	56,000	.225		
39,324	58,000	.232		
40,680	60,000	.240	.006	
42,036	62,000	.247		
43,392	64,000	.255		
44,748	66,000	.262		
46,104	68,000	.270		
47,460	70,000	.279	.009	
48,816	72,000	.286		Elastic limit, approximate.
50,172	74,000	.296		
51,528	76,000	.306		
52,884	78,000	.317		
54,240	80,000	.331	.025	
55,596	82,000	.345		
56,952	84,000	.358		
58,308	86,000	.381		
59,664	88,000	.401		
61,020	90,000	.423	.079	
64,410	95,000	.51		
67,800	100,000	.63		
71,190	105,000	.77		
74,580	110,000	.95		
102,300	150,900			Ultimate strength.

Rail fractured.

Appearance of fracture, granular, radiating from edge of outer flange of base. Small triangular fragment detached from flange.

Permanent deflection, 19 degrees.

No. 790.

STEEL RAIL No 105.

Second specimen.

Section of old rail, branded, "E T 92 11111111."

Height, 4".85.

Width of base, 4".875.

Weight per yard, 78.0 pounds

Ends supported 54" apart.

Loaded on base at the middle.

Additional marks, "North rail (A), M. P. 190 × 2041 Ft. Deg. 2-08', E. 5.25."

Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
678	1,000	0.	0.	Initial load.
6,780	10,000	.044	.002	
13,560	20,000	.087	.002	
20,340	30,000	.124	.003	
23,730	35,000	.147	.....	
27,120	40,000	.161	.003	
30,510	45,000	.178	.....	
33,900	50,000	.197	.004	
35,256	52,000	.204	.....	
36,612	54,000	.212	.....	
37,968	56,000	.219	.....	
39,324	58,000	.226	.....	
40,680	60,000	.234	.005	
42,036	62,000	.242	.....	
43,392	64,000	.249	.....	
44,748	66,000	.256		Elastic limit, approximate.
46,104	68,000	.265	.....	
47,460	70,000	.273	.009	
48,816	72,000	.281	.....	
50,172	74,000	.289	.....	
51,528	76,000	.298	.....	
52,884	78,000	.307	.....	
54,240	80,000	.317	.018	
57,630	85,000	.34	.....	
61,020	90,000	.39	.....	
64,410	95,000	.46		Ultimate strength.
67,800	100,000	.56	.....	
71,190	105,000	.72	.....	
74,580	110,000	.91	.....	
77,600	114,500	.....	.....	

Rail fractured.

Appearance of fracture, granular, radiating from outer edge of running surface of head.

Fractured 3" eccentric.

Detached a piece of base and web 9" long.

Permanent deflection, $1\frac{1}{2}$ degrees.

No. 791.

STEEL RAIL No. 105.

Third specimen.

Section of old rail, branded, "E T 92 11111111."

Height, 4" 85.

Width of base, 4" 875.

Weight per yard, 78.9 pounds.

Ends supported 54" apart.

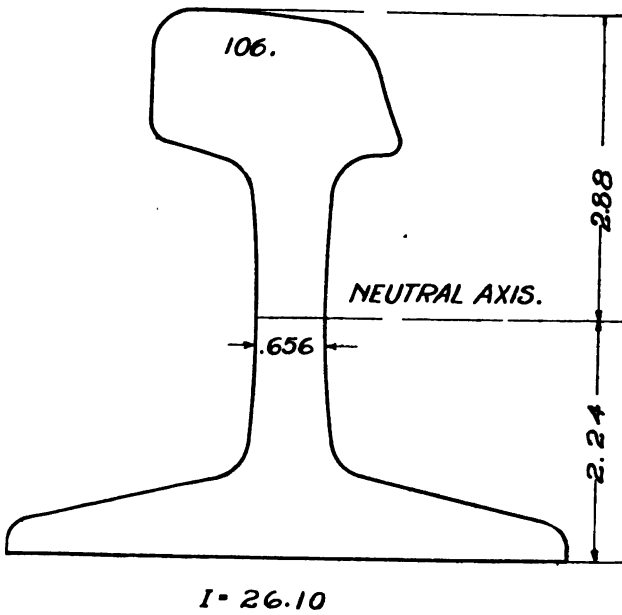
Loaded on head at the middle.

Additional marks, "North rail (A), M. P. 190 × 2041 Ft. Deg. 2-08', E. 5.25."

Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	
678	1,000	0.	0.	Initial load.
6,780	10,000	.044	0.	
13,560	20,000	.088	.001	
20,340	30,000	.124	.001	
23,730	35,000	.143		
27,120	40,000	.161	.002	
30,510	45,000	.178		
33,900	50,000	.197	.002	
35,256	52,000	.203		Rested under initial load 16 hours.
36,612	54,000	.210		
37,968	56,000	.217		
39,324	58,000	.224		
40,680	60,000	.232	.003	
42,036	62,000	.239		
43,392	64,000	.246		
44,748	66,000	.254		
46,104	68,000	.262		
47,460	70,000	.269	.006	
48,816	72,000	.277		
50,172	74,000	.285		
51,528	76,000	.292		
52,884	78,000	.300		Elastic limit, approximate.
54,240	80,000	.310	.012	
55,596	82,000	.317		
56,952	84,000	.328		
58,308	86,000	.337		
59,664	88,000	.348		
61,020	90,000	.364	.029	
64,410	95,000	.42		
67,800	100,000	.51		
71,190	105,000	.65		
74,580	110,000	.81		
108,000	159,300	5.21		Maximum load applied.

Rail not fractured.

Permanent deflection when test was discontinued, 19½ degrees.



No. 794.

STEEL RAIL No. 106.

Third specimen.

Section of old rail, branded, "Carnegie 1907 E T 11111 85."

Height, 5".12.

Width of base, 5".19.

Weight per yard, 78.0 pounds.

Ends supported 54" apart.

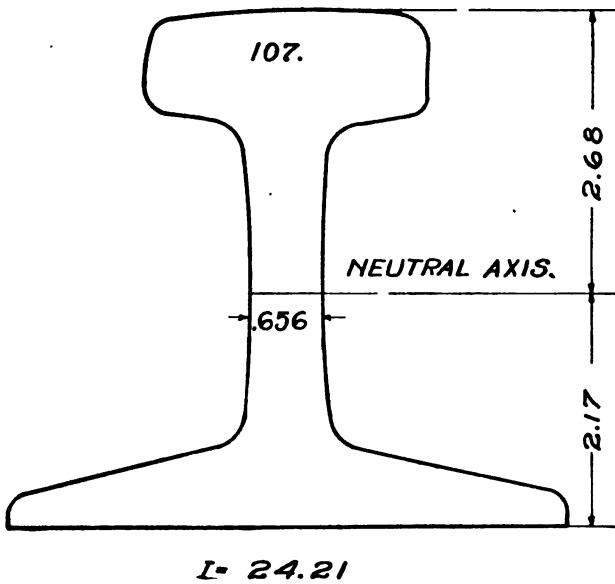
Loaded on head at the middle.

Additional marks, "Taken out on O. G. Bridge. High side of curve,
4 def. rails. Sheridan, Pa."

Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	
671	1,000	0.	0.	Initial load.
6,710	10,000	.043	.001	
13,420	20,000	.064	.001	
20,130	30,000	.119	.001	
23,485	35,000	.137		
26,840	40,000	.152	.002	
30,195	45,000	.170		
33,550	50,000	.187	.004	
34,892	52,000	.194		
36,234	54,000	.201		
37,576	56,000	.209		
38,918	58,000	.217		
40,260	60,000	.224	.009	
41,602	62,000	.234		
42,944	64,000	.243		
44,286	66,000	.252		
45,628	68,000	.262		
46,970	70,000	.272	.023	
48,312	72,000	.283		Elastic limit, approximate.
49,654	74,000	.292		
50,996	76,000	.304		
52,338	78,000	.315		
53,680	80,000	.329	.047	
55,022	82,000	.346		
56,364	84,000	.361		
57,706	86,000	.383		
59,048	88,000	.407		
60,390	90,000	.474	.155	
63,745	95,000	.60		
67,100	100,000	.76		
70,455	105,000	.94		
73,810	110,000	1.17		
77,165	115,000	1.42		
80,520	120,000	1.73		
87,600	130,600	2.00		Ultimate strength.

Rail not fractured.

Permanent deflection when test was discontinued, 11½ degrees.



No. 777.

STEEL RAIL No. 107.

First specimen.

Section of old rail, branded, "Carnegie 1907 E T 11111 85."

Height, 4".85.

Width of base, 5".19.

Weight per yard, 79.8 pounds.

Ends supported 54" apart.

Loaded on base at the middle.

Additional marks, "Taken out on O. G. bridge, Low side of curve,
4 deft. rails. Sheridan, Pa."

Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
669	1,000	0.	0.	Initial load.
6,690	10,000	.037	.001	
13,380	20,000	.074	.001	
20,070	30,000	.111	-----	
26,415	35,000	.121	-----	
26,780	40,000	.137	.001	Ultimate strength.
71,200	100,000	-----	-----	

Rail fractured.

Appearance of fracture granular, radiating from inner edge of running surface of the head.

Permanent deflection, $2\frac{1}{2}$ degrees.

No. 778.

STEEL RAIL No. 107.

Second specimen.

Section of old rail, branded, "Carnegie 1907 E T 11111 85."

Height, 4".85.

Width of base, 5".19.

Weight per yard, 79.2 pounds.

Ends supported 54" apart.

Loaded on head at the middle.

Additional marks, "Taken out on O. G. bridge, Low side of curve,
4 deft. rails. Sheridan, Pa."

Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	
669	1,000	0.	0.	Initial load.
6,690	10,000	.041	.001	
13,380	20,000	.080	.001	
20,070	30,000	.114	.001	
23,415	35,000	.131	.....	
26,760	40,000	.147	.001	
30,105	45,000	.163	.....	
33,450	50,000	.179	.002	
34,788	52,000	.185	.....	
36,126	54,000	.192	.....	
37,464	56,000	.198	.....	
38,802	58,000	.205	.....	
40,140	60,000	.212	.003	
41,478	62,000	.218	.....	
42,816	64,000	.225	.....	
44,154	66,000	.231	.....	
45,492	68,000	.238	.....	
46,830	70,000	.246	.006	
48,168	72,000	.254	.....	
49,506	74,000	.261	.....	
50,844	76,000	.268		Elastic limit, approximate.
52,182	78,000	.276	.....	
53,520	80,000	.284	.013	
54,858	82,000	.293	.....	
56,196	84,000	.302	.....	
57,534	86,000	.311	.....	
58,872	88,000	.325	.....	
60,210	90,000	.343	.039	
63,555	95,000	.40	.....	
66,900	100,000	.50	.....	
70,245	105,000	.63		Ultimate strength.
73,590	110,000	.79	.....	
76,935	115,000	.97	.....	
80,280	120,000	1.19	.....	
96,800	144,700			

Rail fractured.

Appearance of fracture granular, radiating from edge of one flange of base.

Permanent deflection, 9 degrees.

No. 779.

STEEL RAIL No. 107.

Third specimen

Section of old rail, branded, "Carnegie 1907 E T 11111 85."

Height, 4" 85.

Width of base, 5" .19.

Weight per yard, 75.0 pounds.

Ends supported 54' apart.

Loaded on head at the middle.

Additional marks, "Taken out on O. G. bridge, Low side of curve,
4 deft. rails. Sheridan, Pa."

Applied loads.		Deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.			
Pounds.	Pounds.	Inches.	Inch.	
668	1,000	0.	0.	Initial load.
6,680	10,000	.047	.000	
13,360	20,000	.091	.001	
20,070	30,000	.129	.001	
22,415	35,000	.148		
26,760	40,000	.167	.001	
30,105	45,000	.186		
33,450	50,000	.204	.003	
34,788	52,000	.212		
36,126	54,000	.219		
37,464	56,000	.227		
38,802	58,000	.234		
40,140	60,000	.242	.006	
41,478	62,000	.251		
42,816	64,000	.258		
44,154	66,000	.266		Elastic limit, approximate.
45,492	68,000	.275		
46,830	70,000	.285	.012	
48,168	72,000	.295		
49,506	74,000	.304		
50,844	76,000	.315		
52,182	78,000	.328		
53,520	80,000	.342	.033	
54,858	82,000	.366		
56,196	84,000	.392		
57,534	86,000	.437		
58,872	88,000	.478		
60,210	90,000	.534	.185	
63,555	95,000	.68		
66,900	100,000	.88		
70,245	105,000	1.12		
73,590	110,000	1.40		
76,935	115,000	1.71		
80,280	120,000	2.19		
88,000	131,500	5.20		Maximum load applied.

Rail not fractured.

Permanent deflection when test was discontinued, 21 degrees.

TABULATION OF TRANSVERSE TESTS OF STEEL RAILS AFTER BEING IN SERVICE.

Rails supported at the ends, 54" apart. Loaded at the middle.

STEEL RAILS.

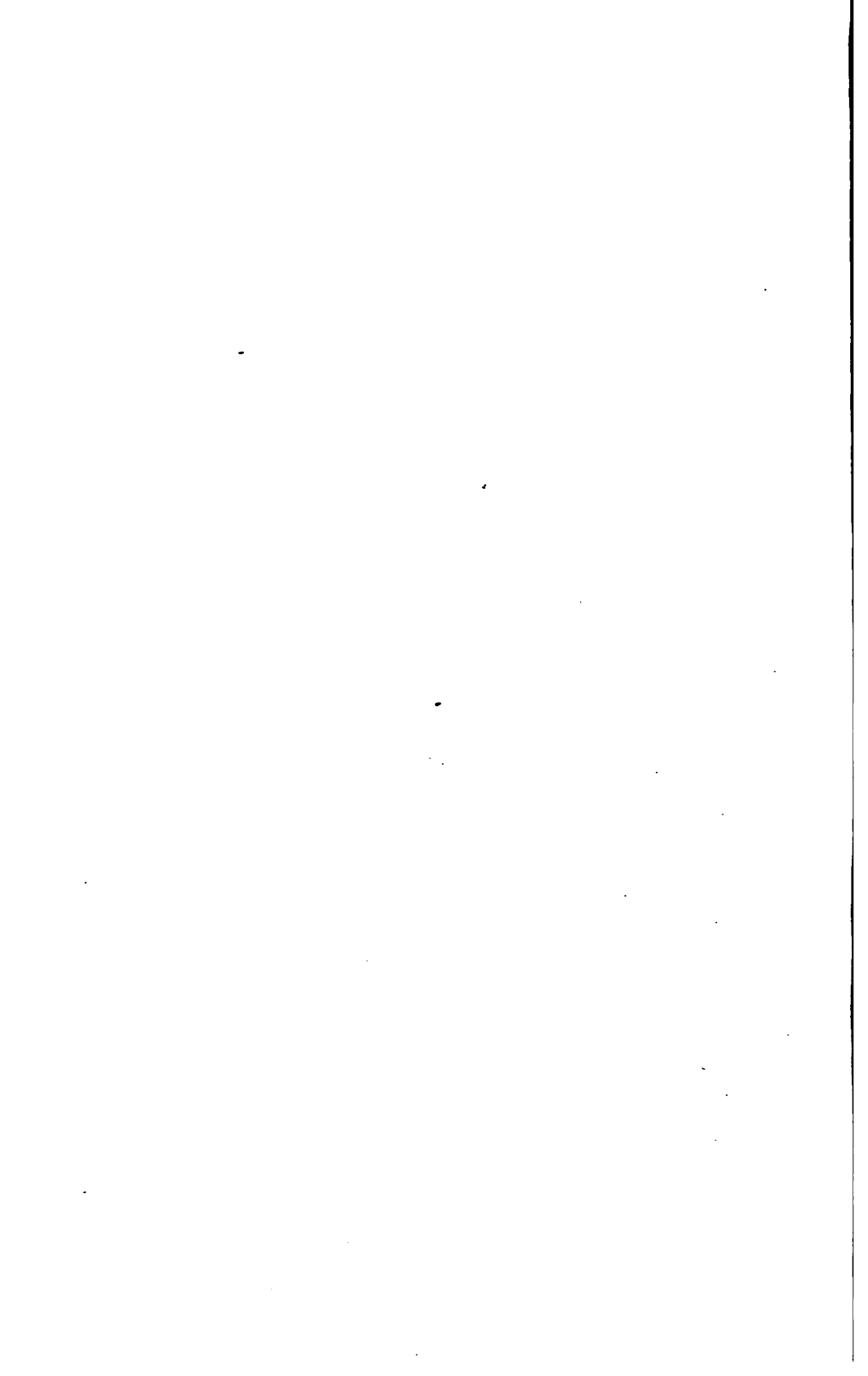
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No. of test rail.	Brand.	Height.	Width of base.	Weight per yard.	Loaded on—	Apparent modulus of elasticity per square inch.	Elastic limit.		Maximum load applied or ultimate strength.		Moment of inertia.	Remarks.
							Total.	Maximum fiber stress per square inch.	Total.	Maximum fiber stress per square inch.		
756	"Carnegie 1902 E. T. 1111"	Inches. 5.52	Inches. 5.75	Pounds. 92.4	Head.	Pounds. 25,327,000	Pounds. 63,036	Pounds. 68,000	Pounds. 136,000	Pounds. 146,700	Inches. 37.55	Not fractured. Permanent deflection, 21 degrees.
757	do.	5.52	5.75	91.2	Base.	25,288,000	63,036	68,000	102,800	110,900	37.55	Fractured. Permanent deflection, 4½ degrees.
758	do.	5.52	5.75	92.4	do.	25,527,000	63,036	68,000	102,300	110,400	37.55	Fractured. Permanent deflection, 4 degrees.
759	"Carnegie 1902 E. T. 11111"	5.56	5.75	92.2	Head.	26,769,000	65,120	74,000	123,200	140,000	35.65	Fractured. Permanent deflection, 8 degrees.
760	do.	5.56	5.75	92.9	Base.	25,748,000	65,120	74,000	100,700	114,400	35.65	Fractured. Permanent deflection, 1½ degrees.
761	do.	5.56	5.75	93.5	Head.	27,427,000	59,940	68,000	134,200	152,500	35.65	Fractured. Permanent deflection, 12½ degrees.
762	do.	5.64	5.75	94.2	do.	24,040,000	62,280	60,000	122,200	117,700	41.63	Not fractured. Permanent deflection, 19½ degrees.
763	do.	5.64	5.75	93.6	Base.	23,527,000	62,280	60,000	101,000	97,300	41.63	Fractured. Permanent deflection, 3½ degrees.
764	do.	5.64	5.75	96.6	Head.	23,488,000	62,280	60,000	126,000	121,400	41.63	Not fractured. Permanent deflection, 12½ degrees. Loaded in alternate directions.
765	do.	5.63	5.75	95.4	do.	23,259,000	58,218	62,000	118,400	128,100	38.30	Not fractured. Permanent deflection, 18 degrees.
766	do.	5.63	5.75	95.1	Base.	23,520,000	61,974	66,000	111,000	118,200	38.30	Fractured. Permanent deflection, 8 degrees.
767	do.	5.63	5.75	96.0	do.	22,491,000	61,974	66,000	107,600	114,600	38.30	Fractured. Permanent deflection, 6 degrees.
768	do.	5.58	5.75	96.6	Head.	24,245,000	58,232	58,000	121,000	120,500	40.40	Not fractured. Permanent deflection, 21 degrees.
769	do.	5.58	5.75	96.6	Base.	24,300,000	58,232	58,000	90,360	90,000	40.40	Fractured. Permanent deflection, 2½ degrees.

TABULATION OF TRANSVERSE TESTS OF STEEL RAILS AFTER BEING IN SERVICE—Continued.

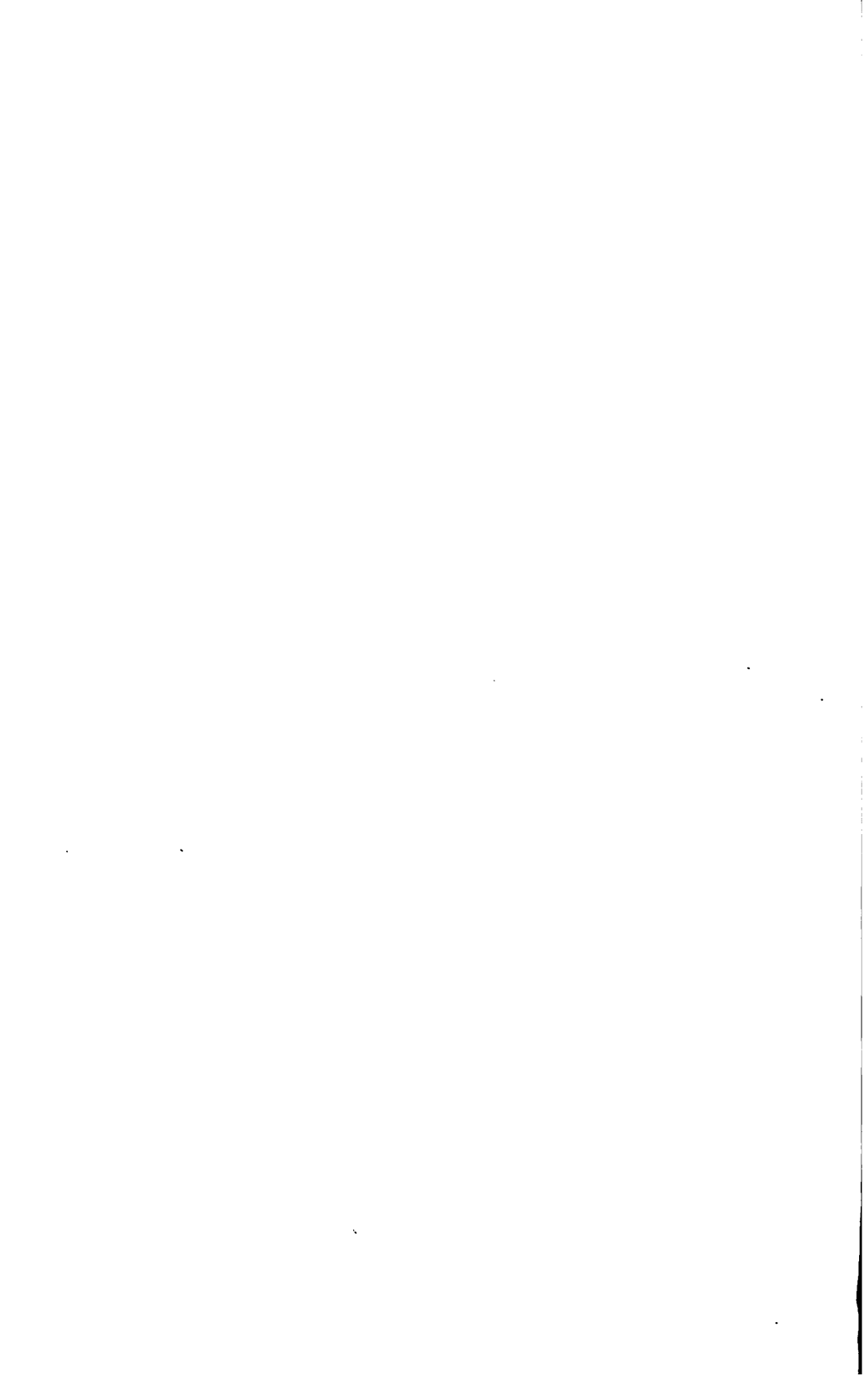
No. of test.	No. of rail.	Brand.	Height.	Width of base.	Weight per yard.	Loaded on—	Apparent modulus of elasticity per square inch.	Elastic limit.		Maximum load applied or ultimate strength.		Moment of inertia.	Remarks.
								Total.	Maximum fiber stress per square inch.	Total.	Maximum fiber stress per square inch.		
770	99	"Carnegie 1902 E. T. 111111"	Inches. 5.58	Inches. 5.75	Pounds. 96.3	Base.	Pounds. 25,677,000	Pounds. 60,240	Pounds. 60,000	Pounds. 114,200	Pounds. 113,700	Inches. 40.40	Not fractured. Permanent deflection, 22 degrees.
771	100	do.	5.65	5.75	92.1	Head.	24,290,000	59,840	68,000	113,100	128,500	37.64	Not fractured. Permanent deflection, 12 degrees.
772	100	do.	5.65	5.75	91.8	Base.	25,933,000	65,120	74,000	114,600	130,200	37.64	Not fractured. Permanent deflection, 19½ degrees.
773	100	do.	5.65	5.75	90.9	do.	26,200,000	61,600	70,000	103,800	119,000	37.64	Fractured. Permanent deflection, 3½ degrees.
774	101	do.	5.61	5.75	96.1	Head.	24,985,000	56,782	58,000	134,500	137,400	39.37	Not fractured. Permanent deflection, 21½ degrees.
775	101	do.	5.61	5.75	96.0	Base.	24,081,000	64,614	68,000	112,600	115,000	39.37	Fractured. Permanent deflection, 4 degrees.
776	101	do.	5.61	5.75	94.8	do.	26,486,000	64,614	68,000	122,000	124,600	39.37	Not fractured. Permanent deflection, 21½ degrees.
780	102	do.	5.64	5.75	93.0	Head.	25,530,000	65,380	70,000	128,200	137,300	39.35	Not fractured. Permanent deflection, 14 degrees.
781	102	do.	5.64	5.75	93.0	Base.	25,890,000	63,512	68,000	119,800	128,300	39.35	Fractured. Permanent deflection, 6½ degrees.
782	102	do.	5.64	5.75	92.7	Head.	25,470,000	63,512	68,000	122,300	130,900	39.35	Not fractured. Permanent deflection, 11 degrees.
783	103	do.	5.62	5.75	96.3	do.	25,330,000	79,248	78,000	150,000	147,600	41.15	Not fractured. Permanent deflection, 8 degrees.
784	103	do.	5.62	5.75	96.0	Base.	25,770,000	77,216	76,000	135,400	133,300	41.15	Fractured. Permanent deflection, 3½ degrees.
785	103	do.	5.62	5.75	95.7	Head.	25,250,000	79,248	78,000	150,000	147,600	41.15	Not fractured. Permanent deflection, 8½ degrees.
786	104	"E. T. 92 11111111"	4.83	4.875	79.8	do.	23,380,000	55,160	70,000	108,100	137,200	26.60	Not fractured. Permanent deflection, 19½ degrees.
787	104	do.	4.83	4.875	79.2	Base.	24,080,000	50,432	64,000	67,768	86,000	26.60	Fractured. Permanent deflection, barely appreciable.

788	104	do.....	4.83	4.875	80.1	Head	22,340,000	50,432	64,000	107,600	136,500	26.60	Fractured. Permanent deflection, 17 degrees.
789	105	do.....	4.85	4.875	78.6	...do...	26,050,000	48,816	72,000	102,300	150,900	23.42	Fractured. Permanent deflection, 19 degrees.
790	105	do.....	4.85	4.875	78.0	Base..	26,290,000	51,528	76,000	77,600	114,500	23.42	Fractured. Permanent deflection, 1½ degrees.
791	105	do.....	4.85	4.875	78.9	Head	26,750,000	52,884	78,000	108,000	159,300	23.42	Not fractured. Permanent deflection, 19½ degrees.
792	106	"Carnegie 1907 E. T. 11111185".	5.12	5.19	78.6	...do...	25,890,000	48,312	72,000	86,000	128,200	26.10	Not fractured. Permanent deflection, 13½ degrees.
793	106	do.....	5.12	5.19	78.0	Base..	25,630,000	48,312	72,000	77,165	115,000	26.10	Fractured. Permanent deflection, 3 degrees.
794	106	do.....	5.12	5.19	78.0	Head	25,400,000	48,312	72,000	87,600	130,600	26.10	Not fractured. Permanent deflection, 11½ degrees.
777	107	do.....	4.85	5.19	79.8	Base..	28,824,000	.....	.....	71,200	106,400	24.21	Fractured. Permanent deflection, 2½ degrees.
778	107	do.....	4.85	5.19	79.2	Head	27,910,000	53,520	80,000	96,800	144,700	24.21	Fractured. Permanent deflection, 9 degrees.
779	107	do.....	4.85	5.19	75.0	...do...	24,840,000	45,492	68,000	88,000	131,500	24.21	Not fractured. Permanent deflection, 21 degrees.



STEEL RAILS.

**VIEWS OF STREAKS AND MARKS ON LONGITUDINAL
AND CROSS SECTIONS OF STEEL RAILS, AND
PHOTOMICROGRAPHS OF THERMAL
CRACKS AND FISSURES.**





RAIL NO. 63.

OLD ENGLISH STEEL RAIL. LANDORE SIEMENS STEEL, 2-72, NAYLOR & CO., SECTION 70. LONGITUDINAL STREAKS IN HEAD.
POLISHED AND ETCHED SPECIMEN.





RAIL NO. 63.

OLD ENGLISH STEEL RAIL. LANDORE SIEMENS STEEL, 2-72, NAYLOR & CO., SECTION 70. LONGITUDINAL STREAKS IN BASE.
POLISHED AND ETCHED SPECIMEN.



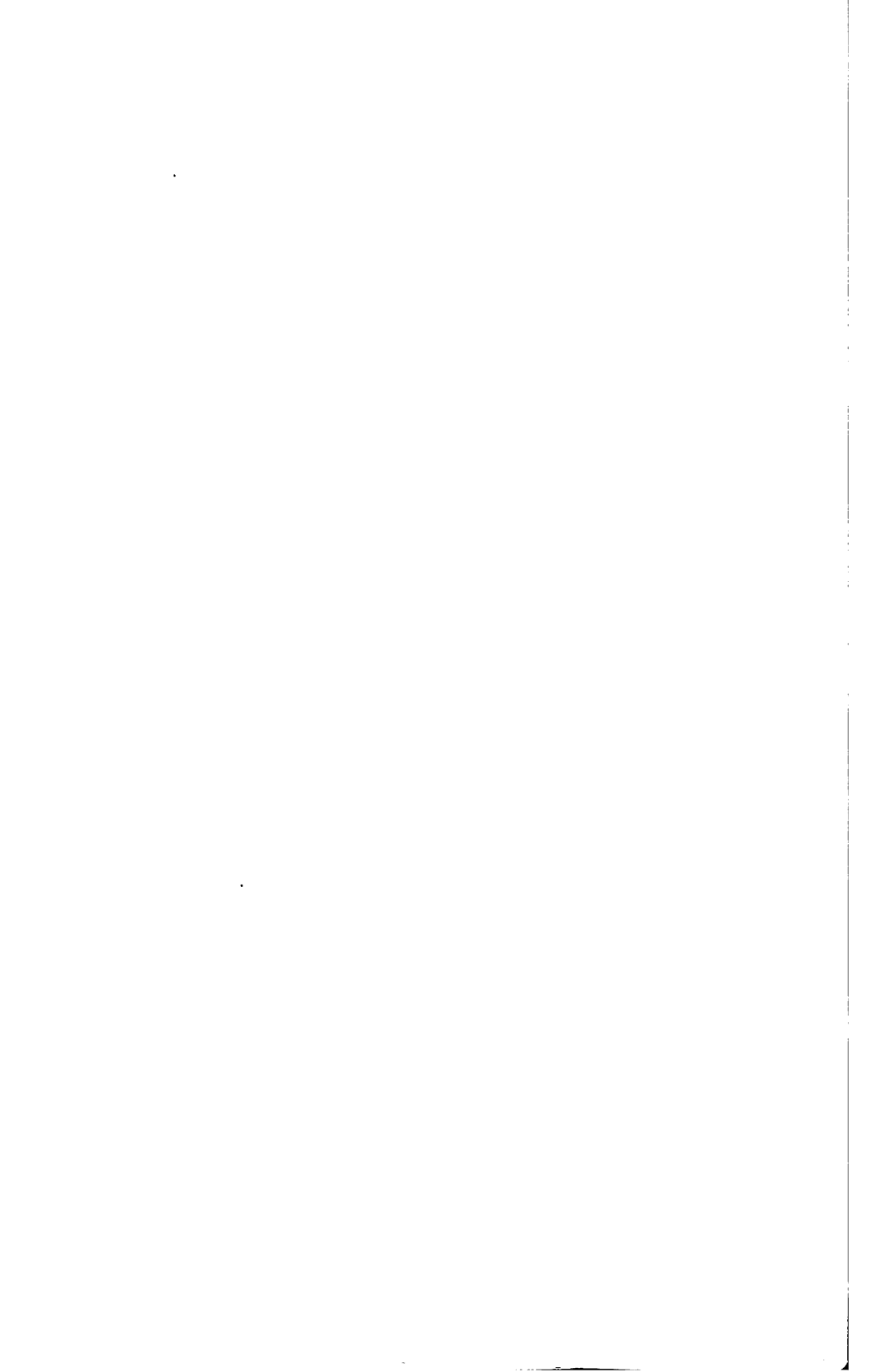
RAIL NO. 41.

OLD ENGLISH STEEL RAIL. CAMMEL TOUGHENED SHEFFIELD STEEL, 1872. LONGITUDINAL STREAKS IN BASE.
POLISHED AND ETCHED SPECIMEN.



RAIL NO. 46.

OLD ENGLISH STEEL RAIL. JOHN BROWN & CO., SHEFFIELD ATLAS STEEL, 3-74, SECTION 68. LONGITUDINAL STREAKS IN BASE.
POLISHED AND ETCHED SPECIMEN.





RAIL NO. 60.

OLD ENGLISH STEEL RAIL. CAMMEL TOUGHENED SHEFFIELD STEEL, 1873. LONGITUDINAL STREAKS IN BASE.
POLISHED AND ETCHED SPECIMEN.



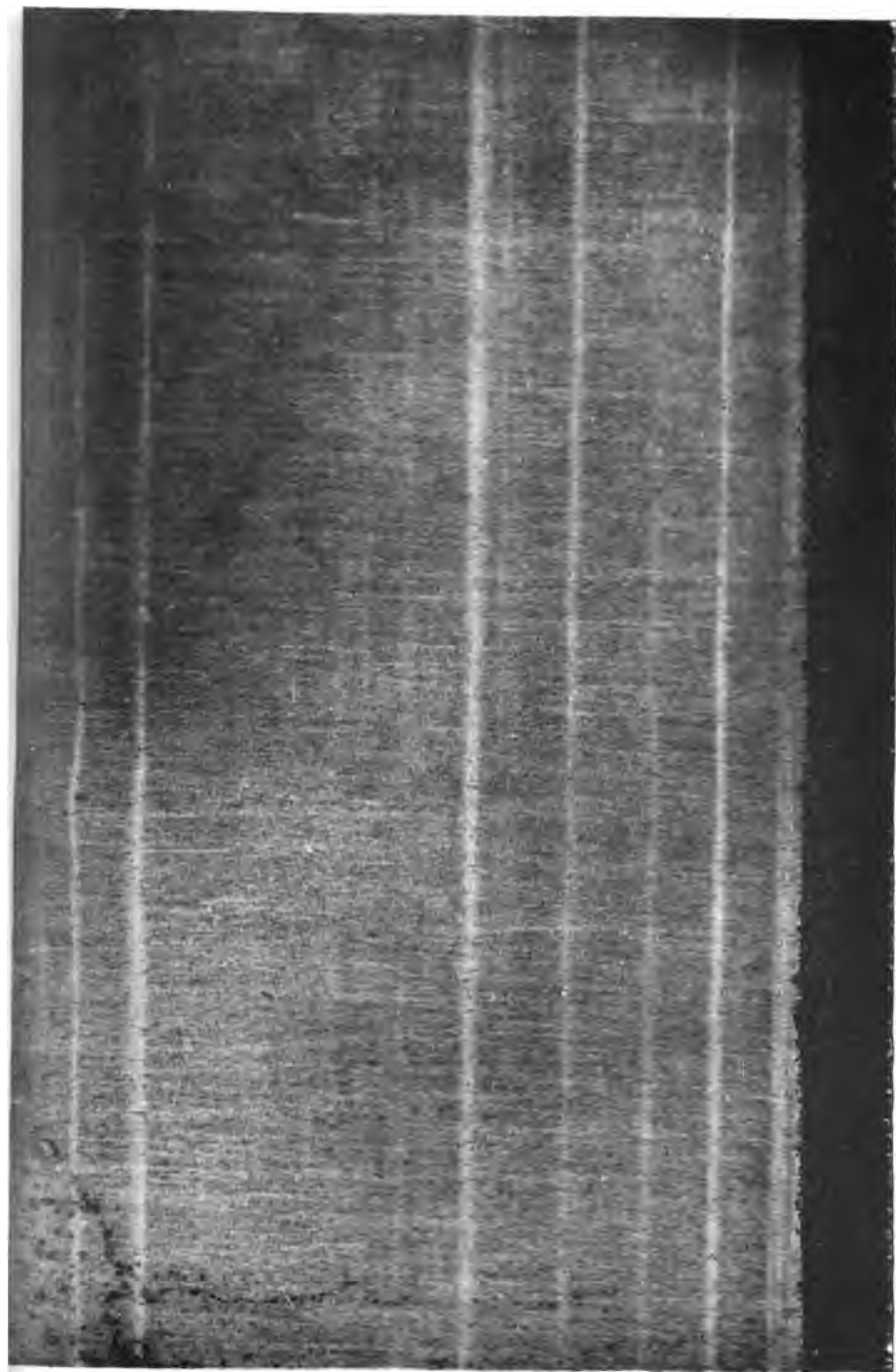


RAIL NO. 41.

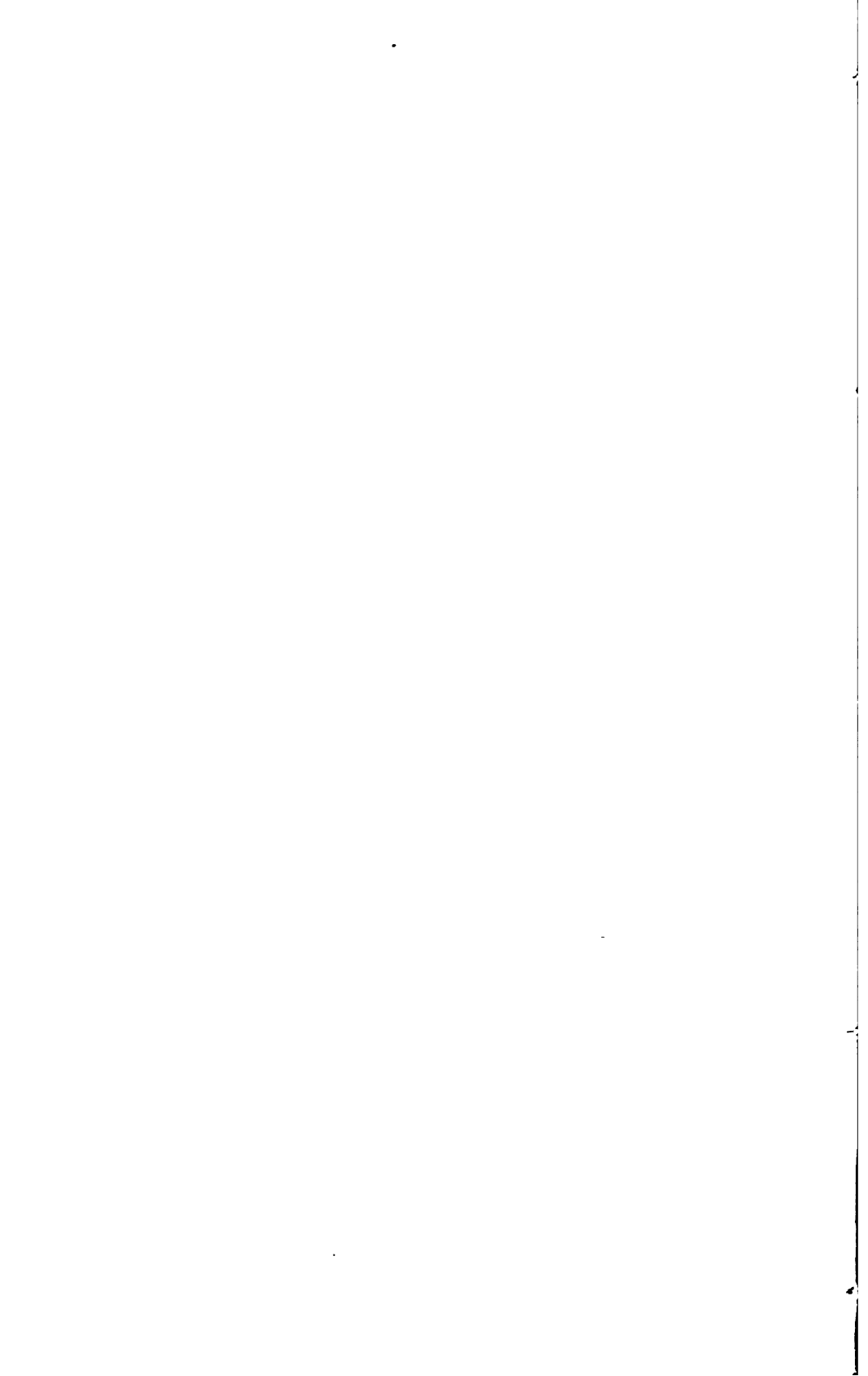
OLD ENGLISH STEEL RAIL. CAMMEL TOUGHENED SHEFFIELD STEEL, 1872.
CROSS SECTION. POLISHED AND ETCHED SPECIMEN.

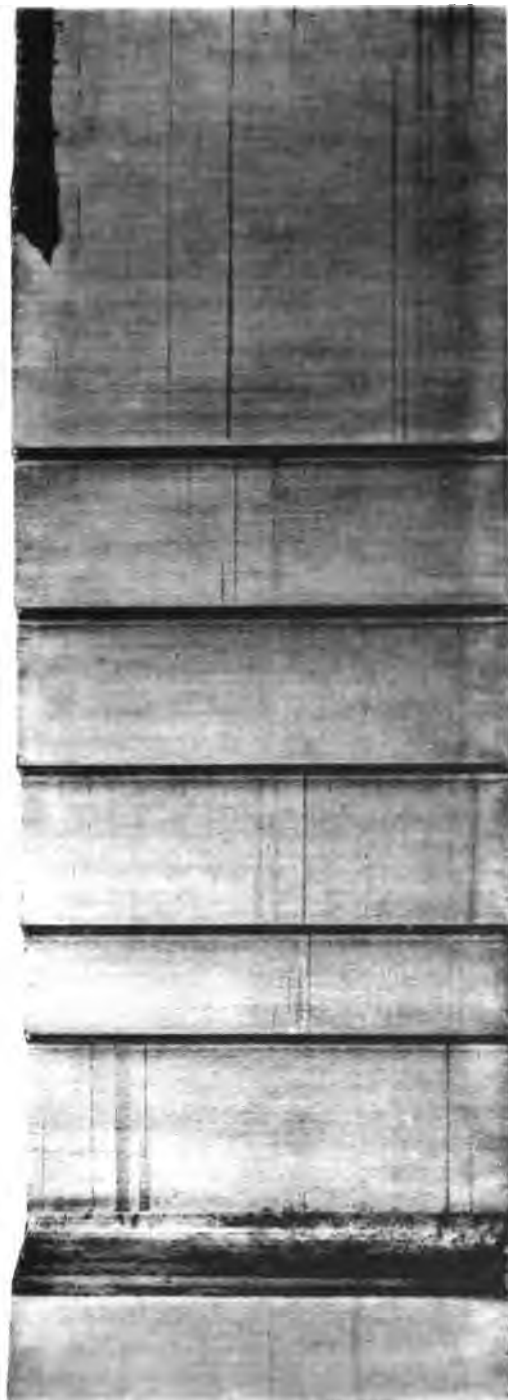


STEEL RAIL, CURRENT DOMESTIC MANUFACTURE. LONGITUDINAL STREAKS IN HEAD. POLISHED AND ETCHED SPECIMEN.

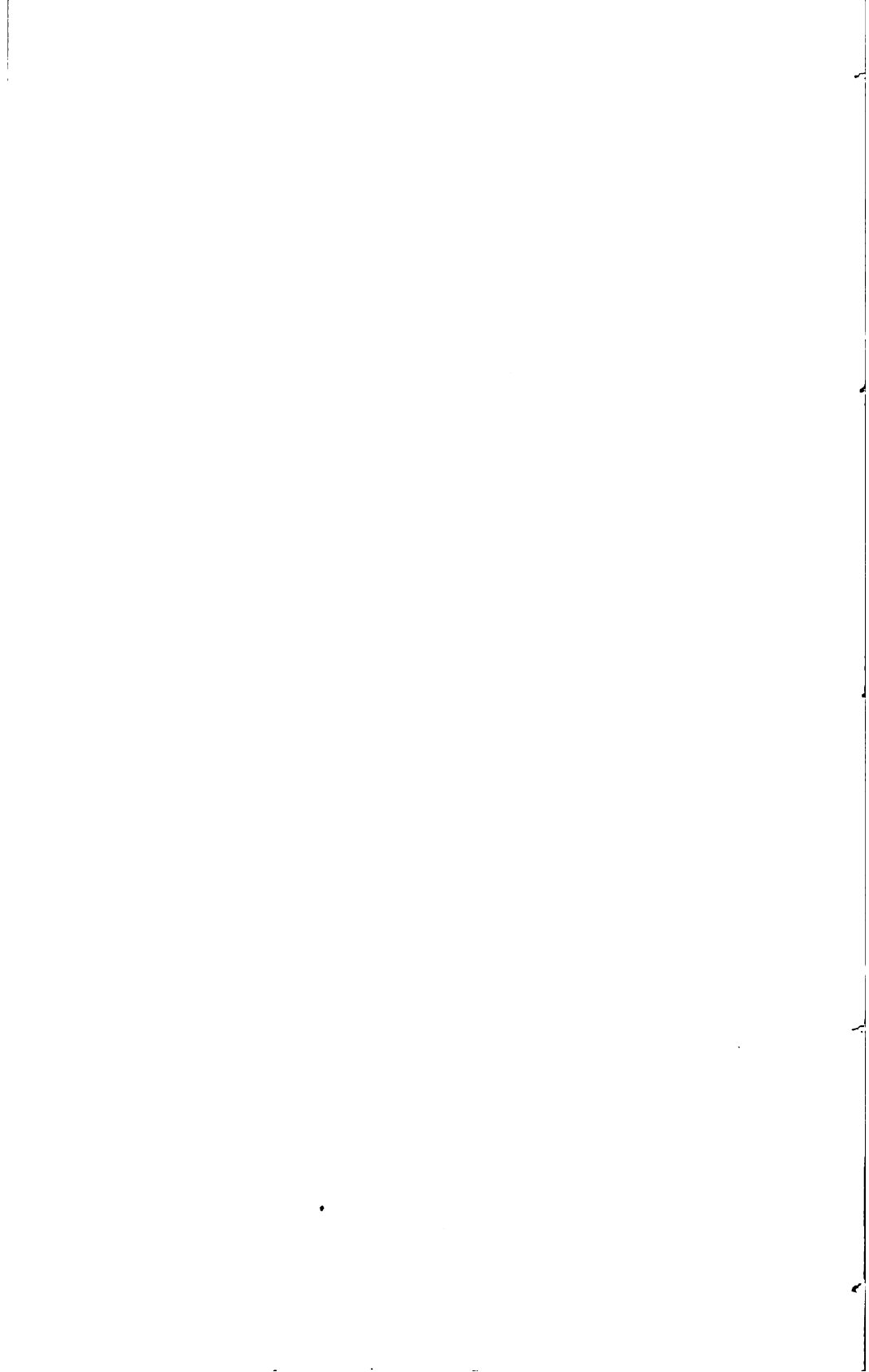


STEEL RAIL, CURRENT DOMESTIC MANUFACTURE. LONGITUDINAL STREAKS IN HEAD. POLISHED AND ETCHED SPECIMEN.
MAGNIFICATION 3 DIAMETERS.





STEEL RAIL, CURRENT DOMESTIC MANUFACTURE. LONGITUDINAL STREAKS IN HEAD ON POLISHED AND ETCHED SECTIONS, PLANED OFF AT DIFFERENT DEPTHS.

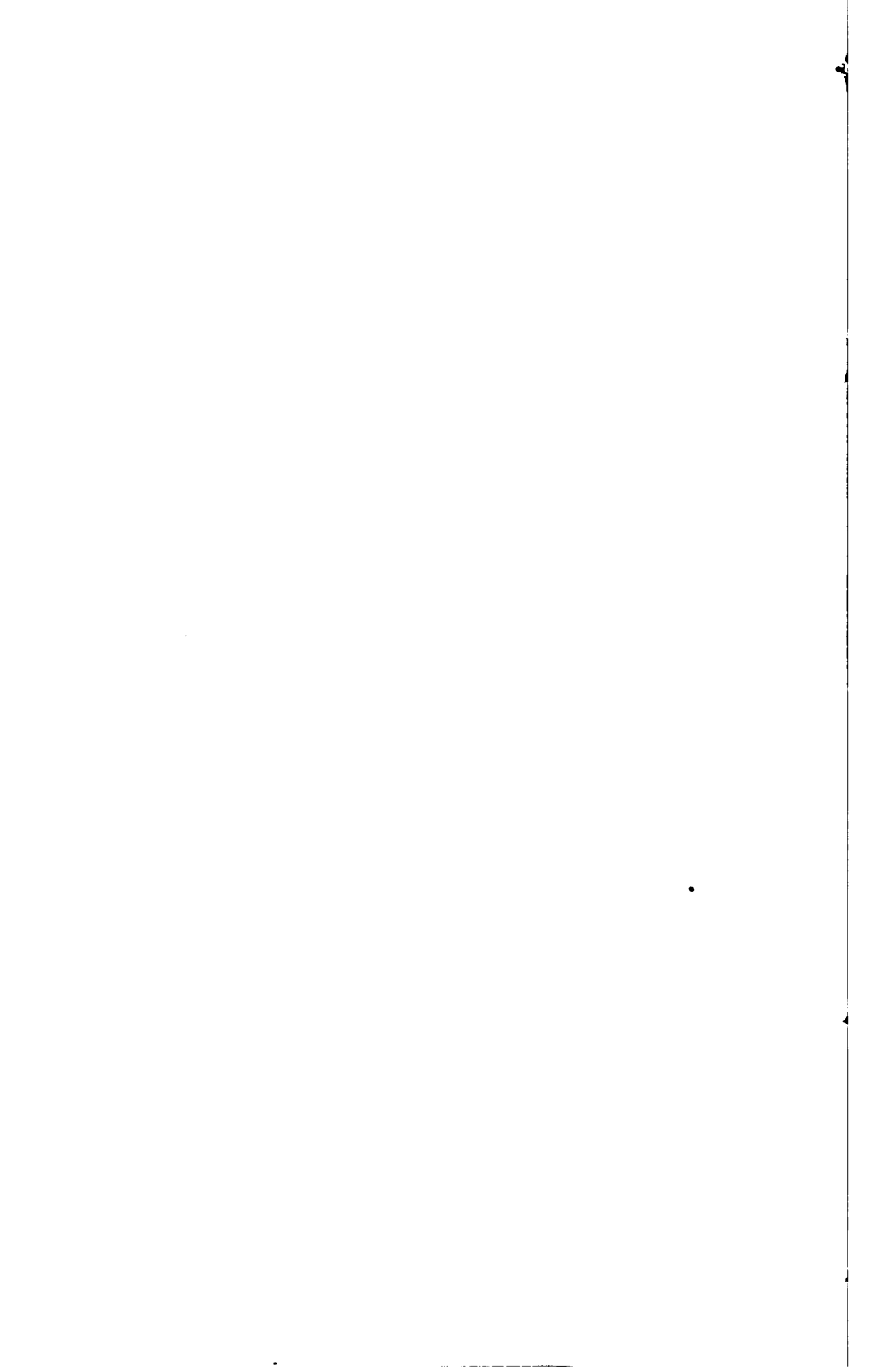


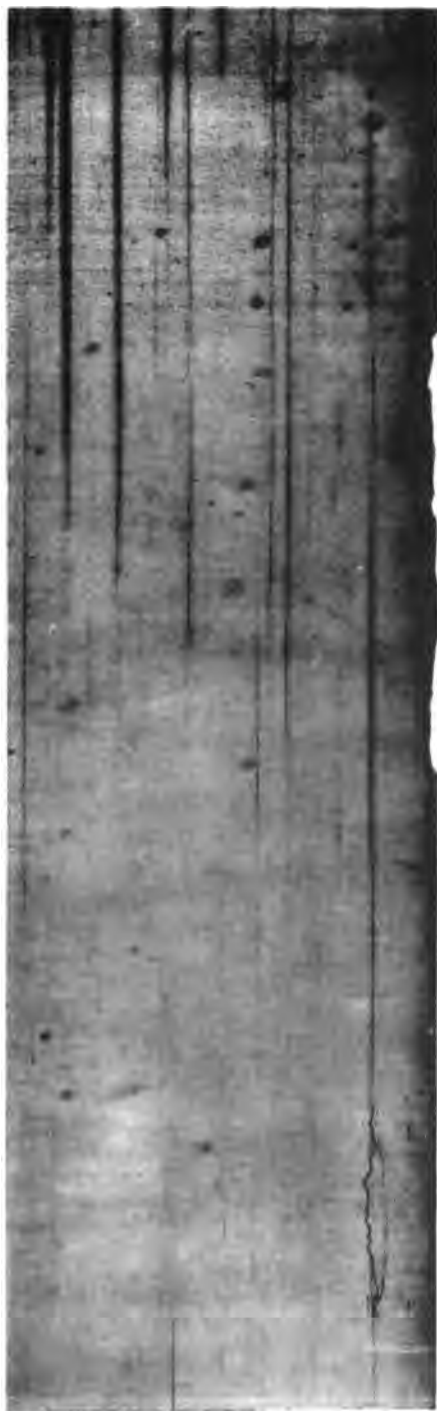


STEEL RAIL, CURRENT DOMESTIC MANUFACTURE. LONGITUDINAL STREAKS IN HEAD ON PLANED AND ETCHED SECTIONS, PLANED OFF AT DIFFERENT DEPTHS.



STEEL RAIL, CURRENT DOMESTIC MANUFACTURE. LONGITUDINAL STREAKS IN HEAD, ON POLISHED AND ETCHED SURFACE AT TWO DEPTHS, SHOWING CONNECTION BETWEEN SAME AND END MARKINGS ON INTERMEDIATE BEVELLED SECTION.





RAIL NO. 82.

STEEL RAIL, RECENT DOMESTIC MANUFACTURE. LONGITUDINAL STREAKS IN HEAD, SHORT FISSURE OPENED ON THE LINE
OF A STREAK. POLISHED AND ETCHED SPECIMEN.

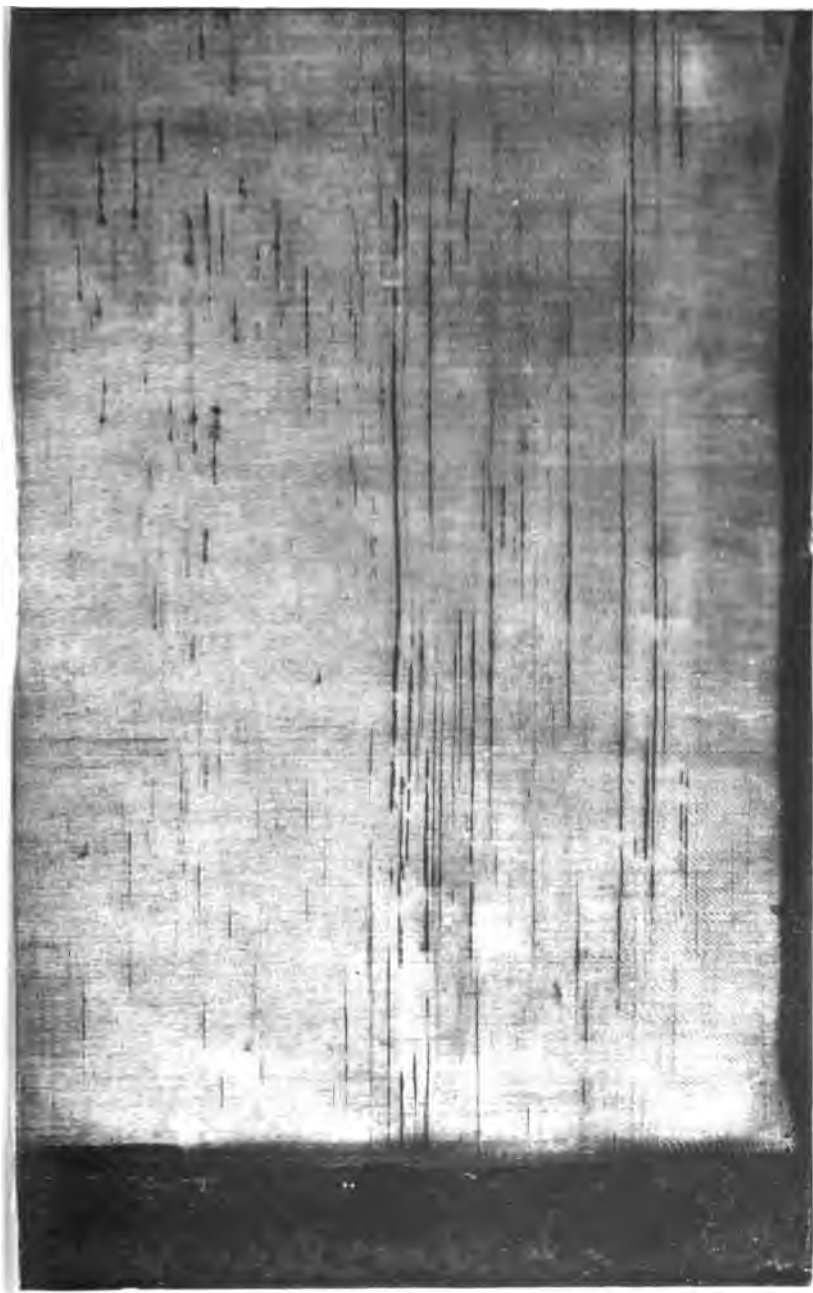


RAIL NO. 50.

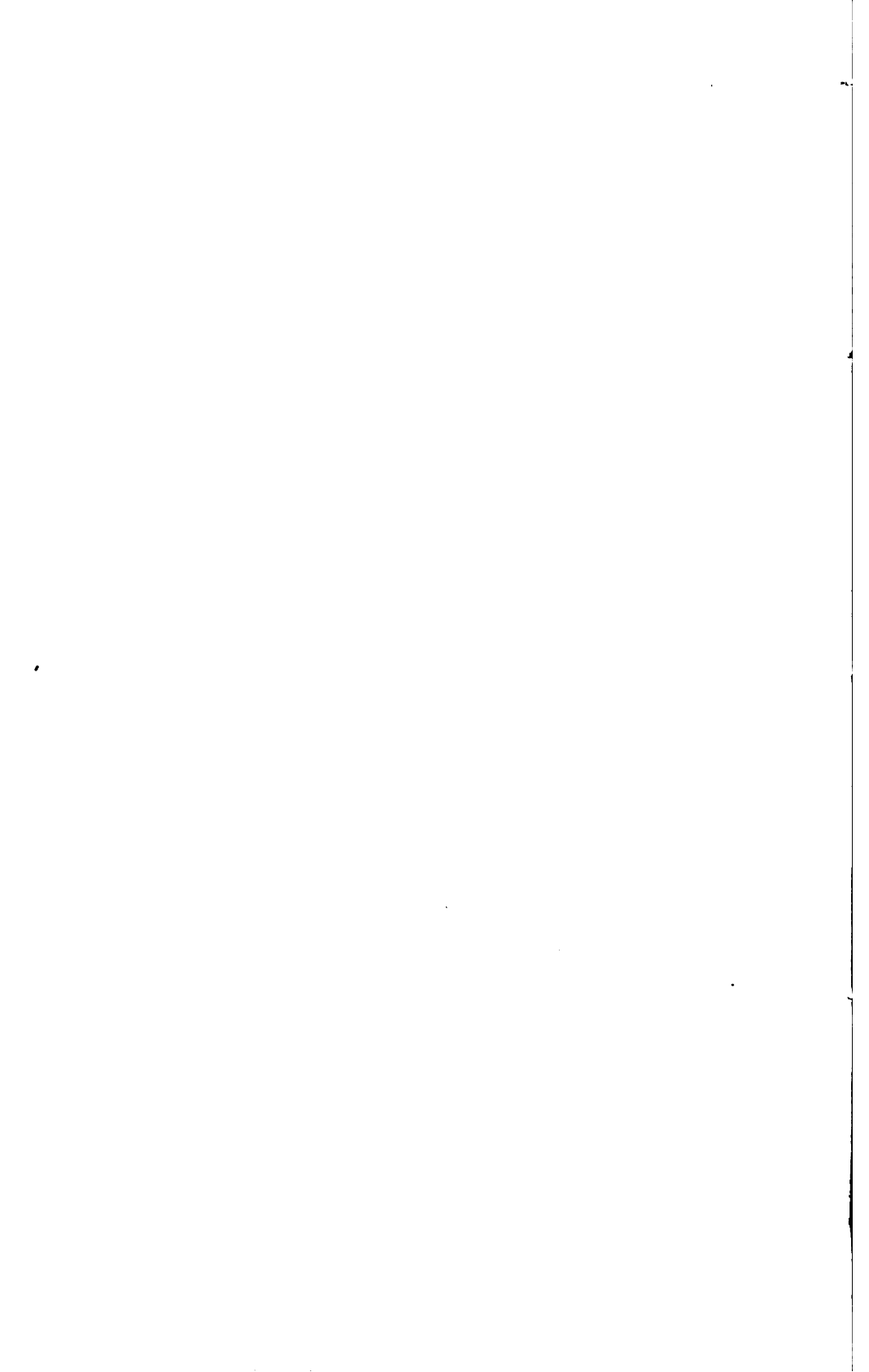
EARLY DOMESTIC STEEL RAIL. JOHN A. GRISWOLD STEEL. LONGITUDINAL STREAKS IN BASE. POLISHED AND ETCHED SPECIMEN.

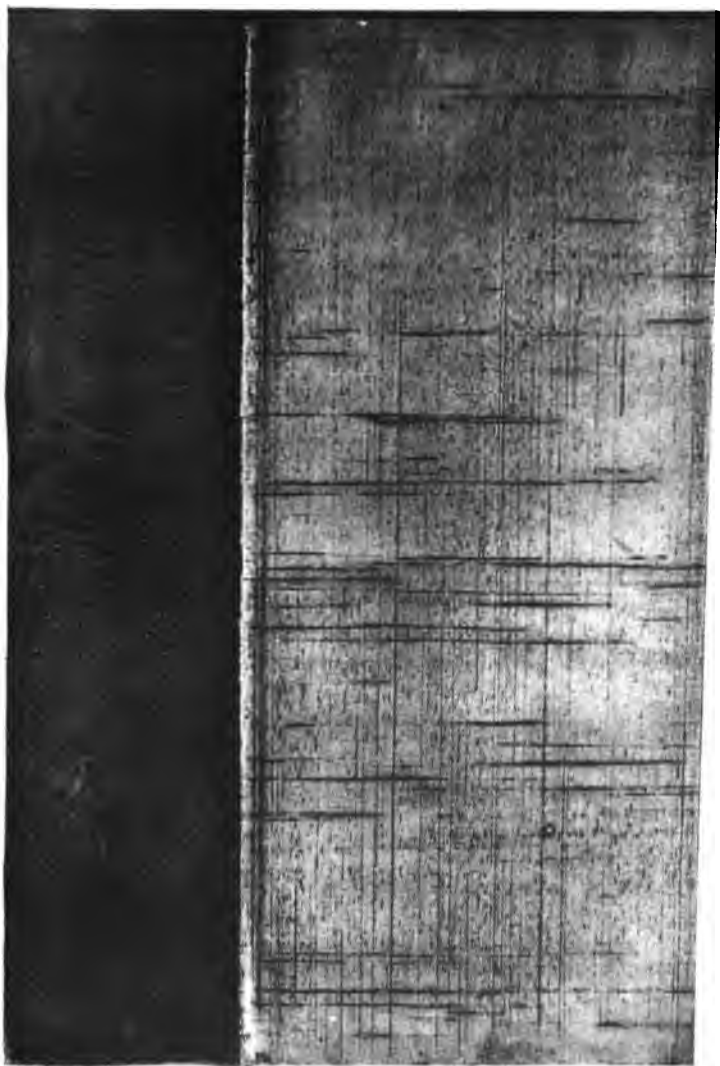
E. O. COCKAYNE—BOSTON





RAIL NO. 56.
EARLY DOMESTIC STEEL RAIL. P. S. CO., 1885. LONGITUDINAL STREAKS IN BASE.
POLISHED AND ETCHED SPECIMEN.

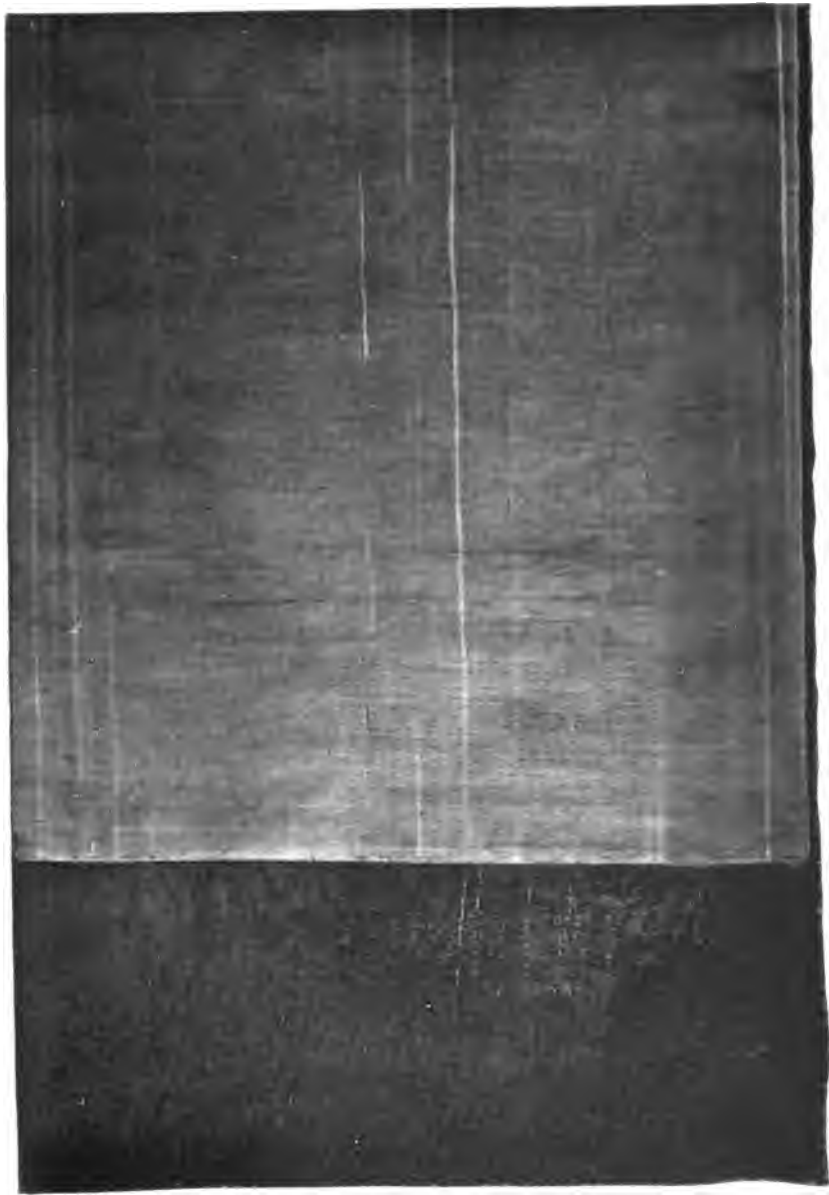




RAIL NO. 68.

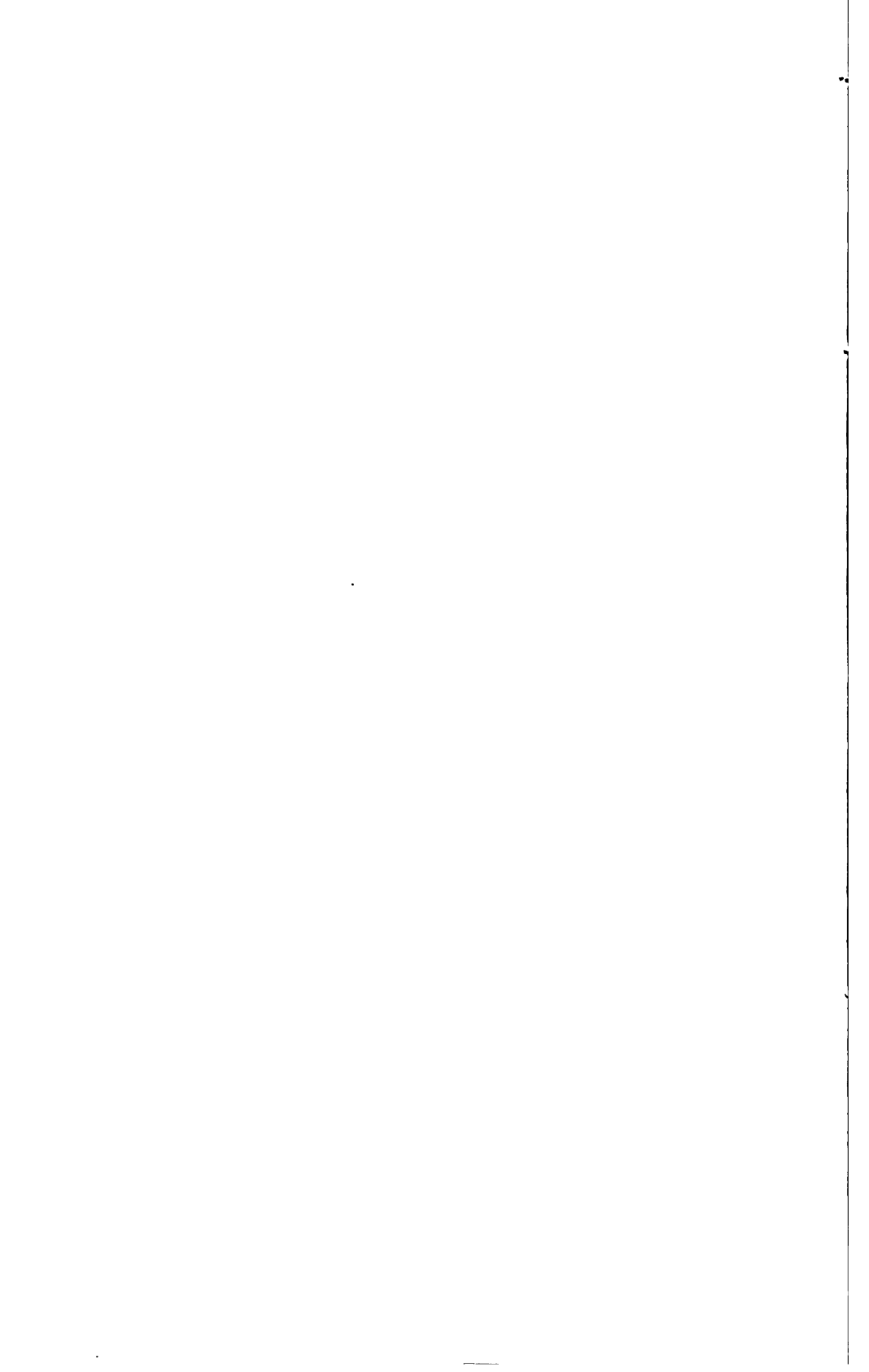
STEEL RAIL, CURRENT DOMESTIC MANUFACTURE. 100 LBS. SECTION.
LONGITUDINAL STREAKS IN BASE. POLISHED AND ETCHED SPECIMEN.

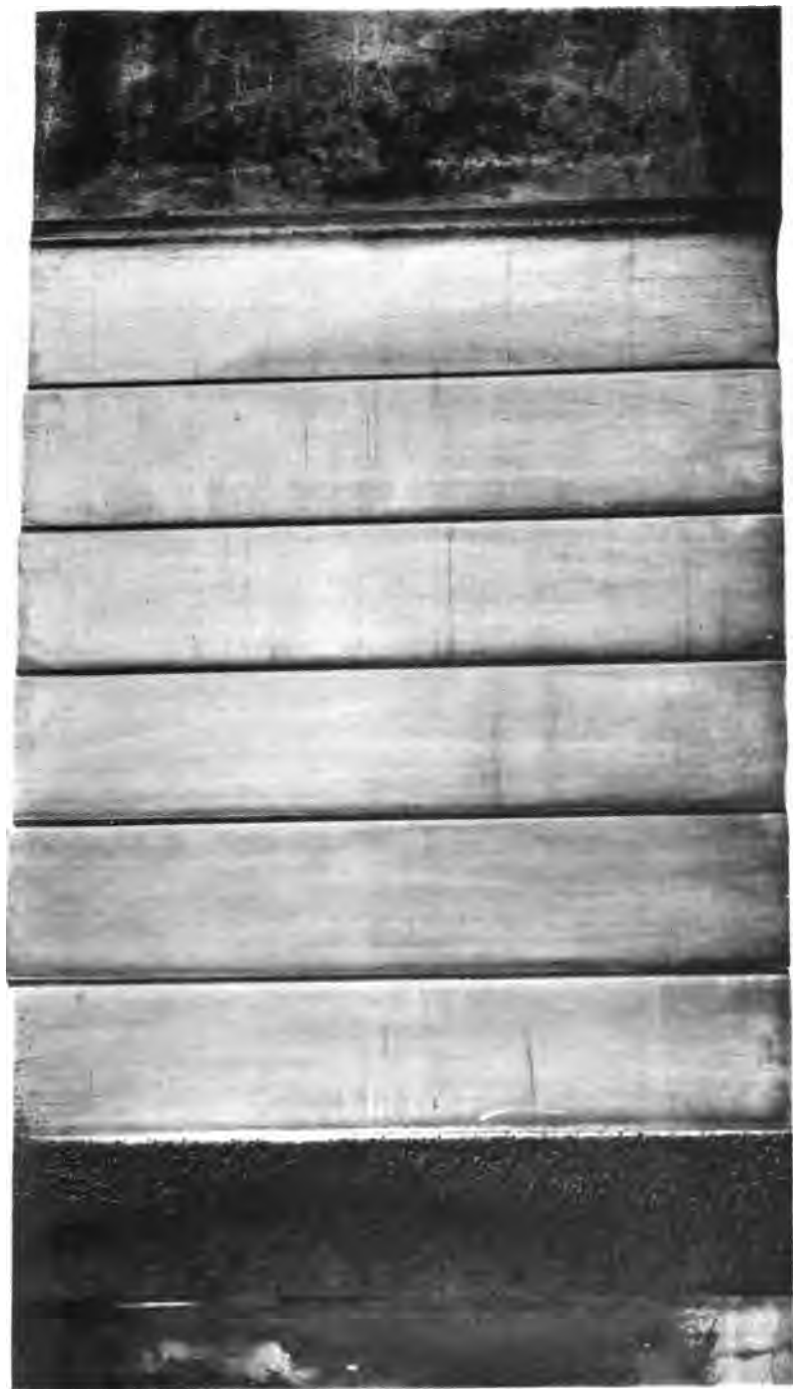




RAIL NO. 79.

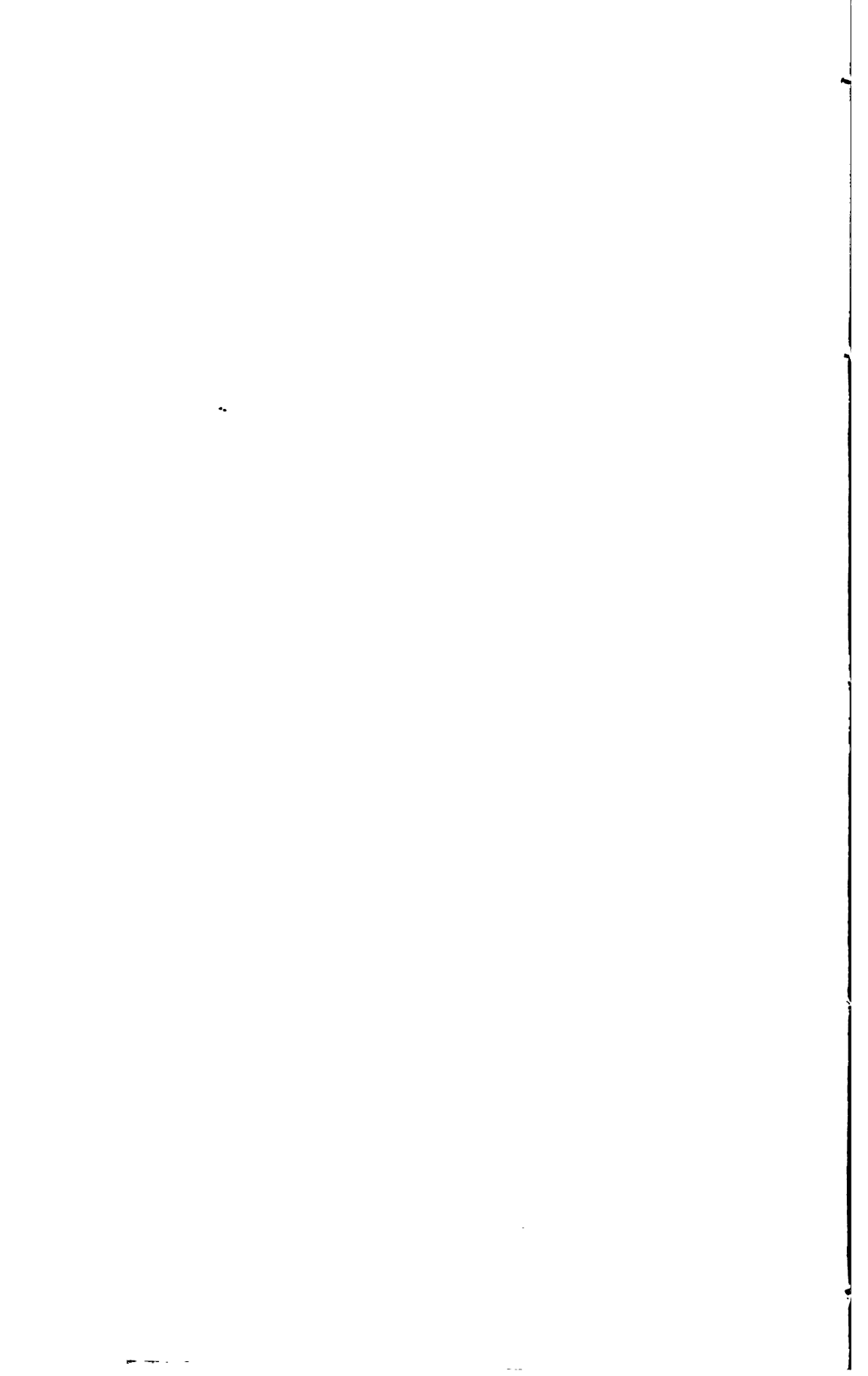
STEEL RAIL, CURRENT DOMESTIC MANUFACTURE. LONGITUDINAL STREAKS IN BASE, ON POLISHED AND ETCHED SECTION, IN
CONTINUATION OF THOSE ON ROLLED SURFACE OF THE METAL.

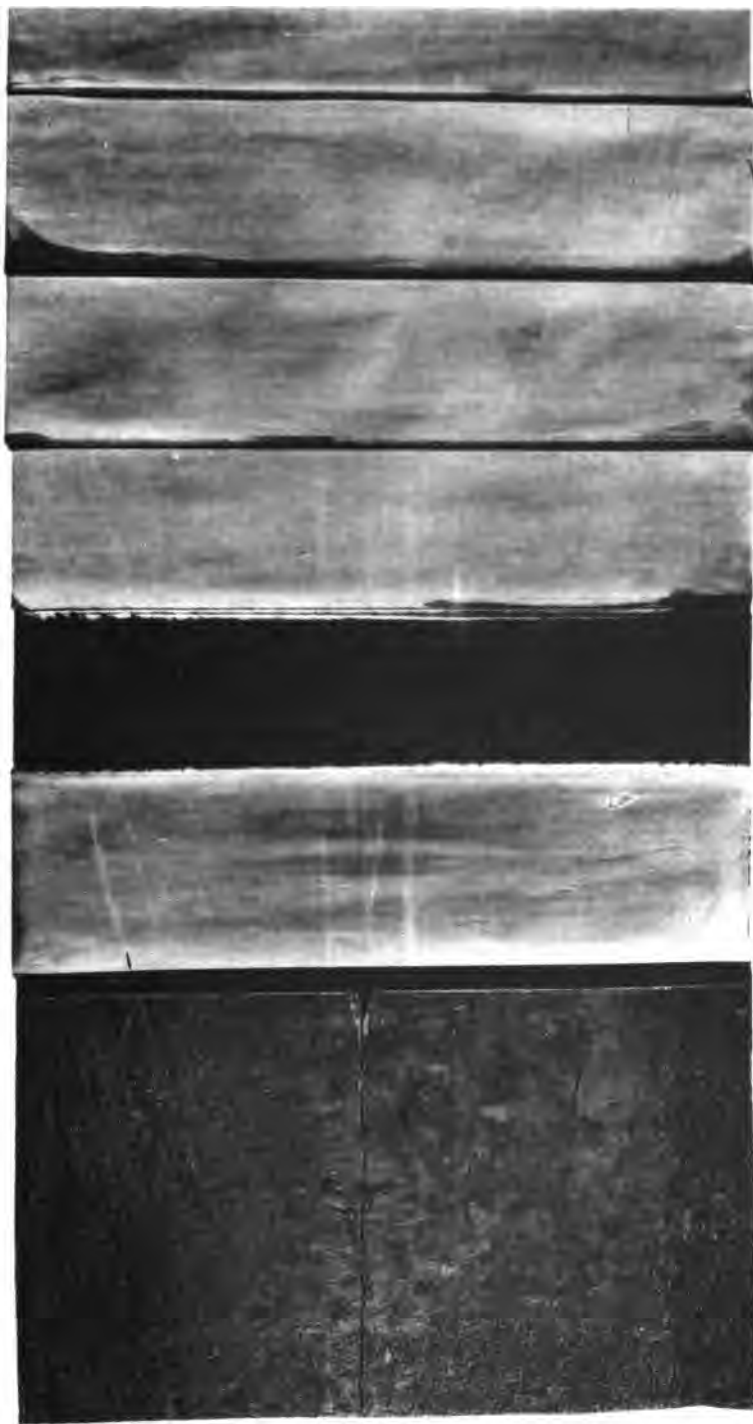




STEEL RAIL, CURRENT DOMESTIC MANUFACTURE. LONGITUDINAL STREAKS IN THE BASE, ON POLISHED AND ETCHED SECTIONS, PLANED OFF AT DIFFERENT DEPTHS.

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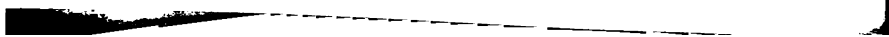
RAIL NO. 80.

STEEL RAIL, CURRENT DOMESTIC MANUFACTURE. LONGITUDINAL STREAKS IN BASE, ON POLISHED AND ETCHED SECTION, IN CONTINUATION OF THOSE ON ROLLED SURFACE OF THE METAL. ALSO LONGITUDINAL FRACTURE IN BASE, MADE IN THE TESTING MACHINE.



RAIL NO. 68.

STEEL RAIL, CURRENT DOMESTIC MANUFACTURE. CROSS SECTION.
POLISHED AND ETCHED SPECIMEN.





RAIL NO. 69.

STEEL RAIL, CURRENT DOMESTIC MANUFACTURE. BENDING TESTS MADE ON A THIN SECTION, POLISHED AND ETCHED, DEVELOPING FRACTURES ON LINE OF STREAKS OR AT DARK COLORED SPOTS. RAIL SECTION CUT APART BEFORE BENDING, DETACHING WEB FROM BASE AND HEAD.

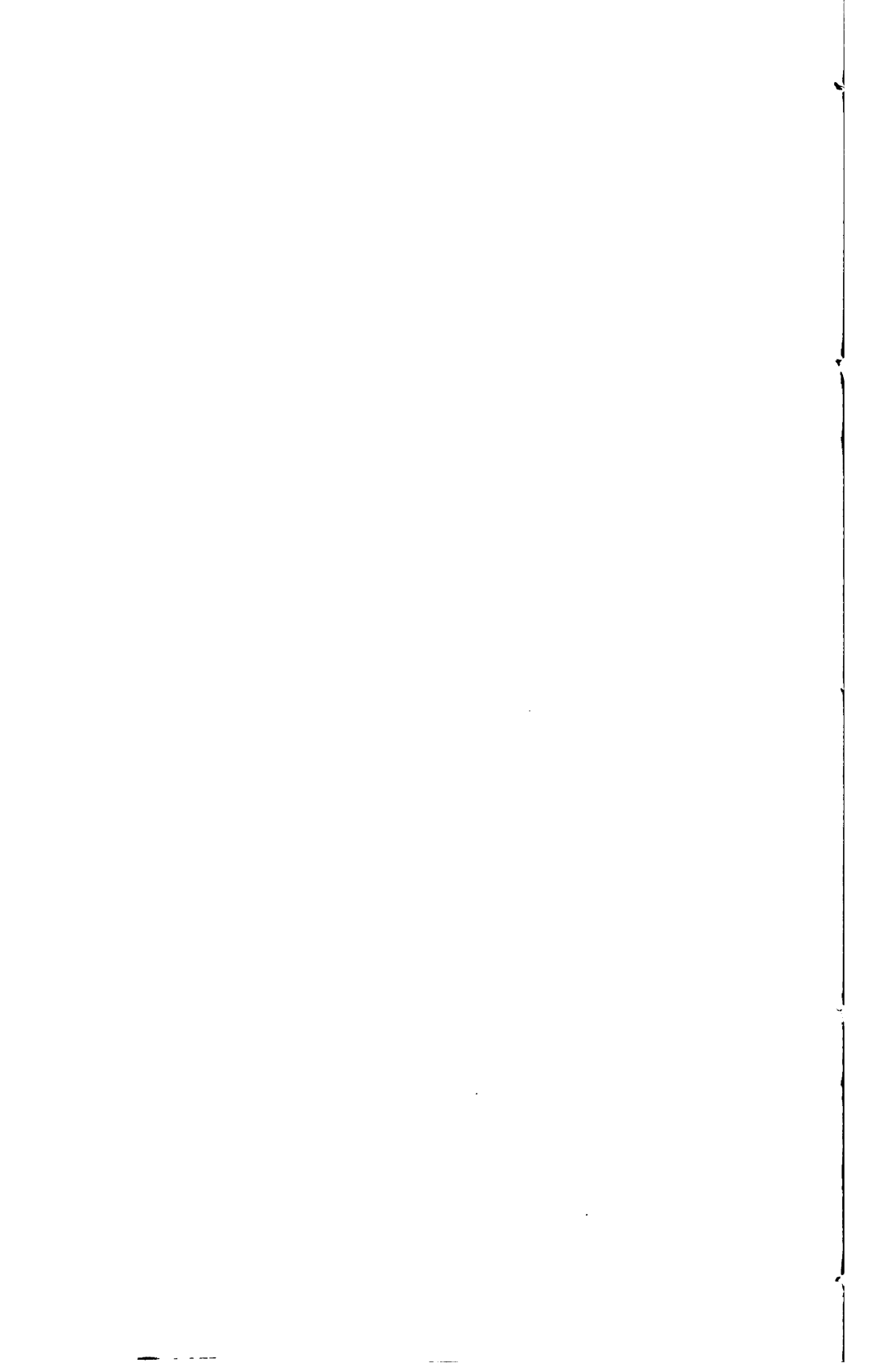


STEEL RAIL, CURRENT DOMESTIC MANUFACTURE. SPECIMEN POLISHED AND ETCHED,
SHOWING CONNECTION BETWEEN END MARKINGS AND LONGITUDINAL STREAKS.



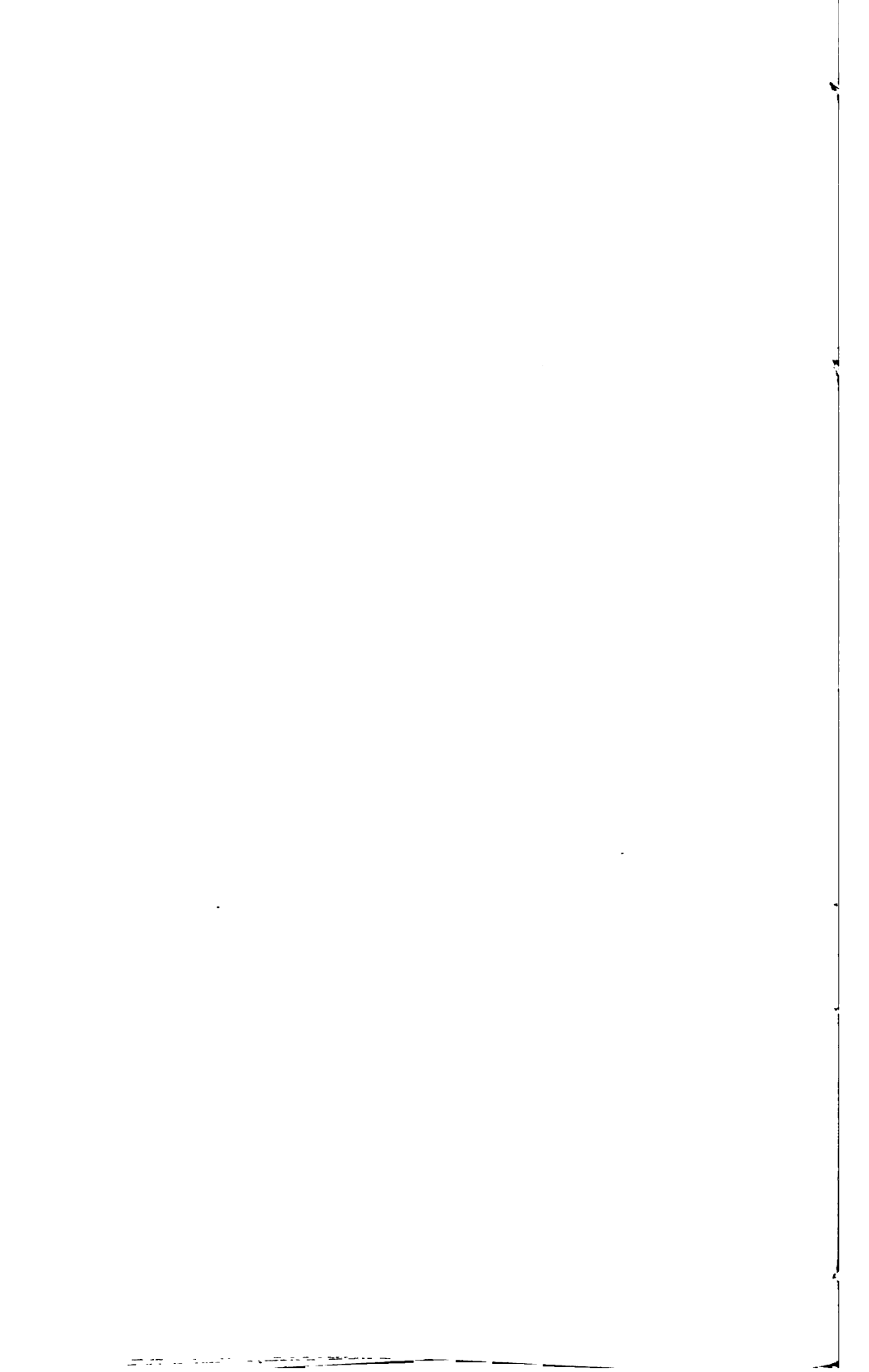
RAIL NO. 78.

LONGITUDINAL FRACTURE OF THE BASE, MADE IN THE TESTING MACHINE, ON THE LINE OF STREAKED METAL, AND IN CONTINUATION
OF A CRESCENT SHAPED FRACTURE WHICH OCCURRED IN SERVICE.





SIDE VIEW OF RAIL, BROKEN IN THE TESTING MACHINE BY TRANSVERSE LOADS SHOWING SCALE DETACHED FROM SURFACE OF WEB.

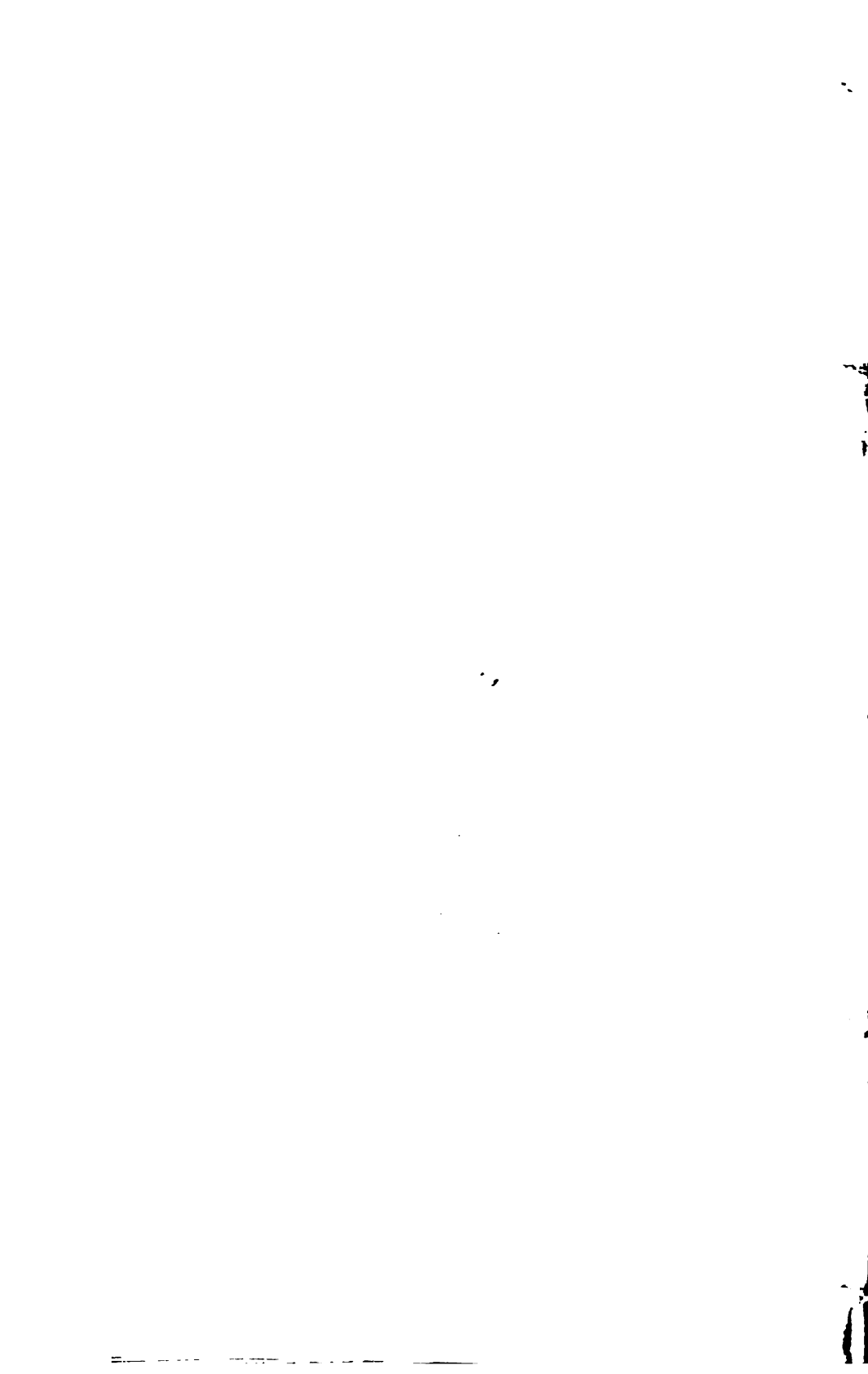




APPEARANCE OF RUNNING SURFACE OF HEAD OF STEEL RAIL, SHOWING ROUGHENED
SURFACE CAUSED BY SLIPPING OF WHEELS OF LOCOMOTIVES.
CUT REPRODUCED FROM REPORT OF 1906.



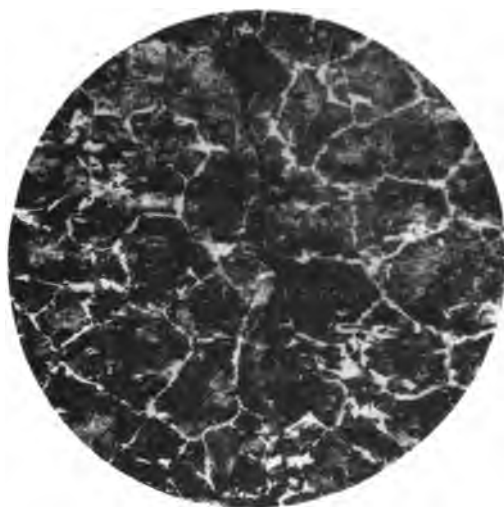
PHOTOMICROGRAPH OF THERMAL CRACK IN HEAD OF RAIL. PART NEXT
RUNNING SURFACE. LONGITUDINAL SECTION OF RAIL HEAD.
MAGNIFICATION 110 DIAMETERS.





PHOTOMICROGRAPH OF THERMAL CRACK IN HEAD OF RAIL, INTERMEDIATE
PART. LONGITUDINAL SECTION OF RAIL HEAD.
MAGNIFICATION 110 DIAMETERS.

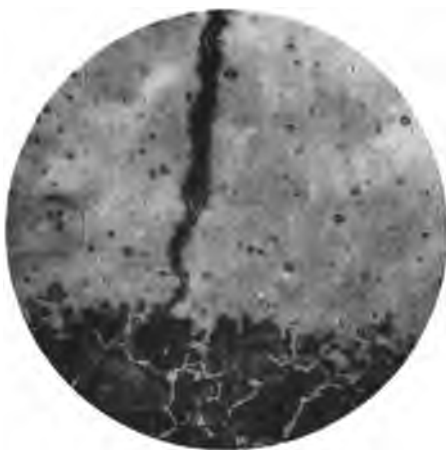




PHOTOMICROGRAPH OF THERMAL CRACK IN HEAD OF RAIL, LOWER PART
OF CRACK. LONGITUDINAL SECTION OF RAIL HEAD.
MAGNIFICATION 110 DIAMETERS.

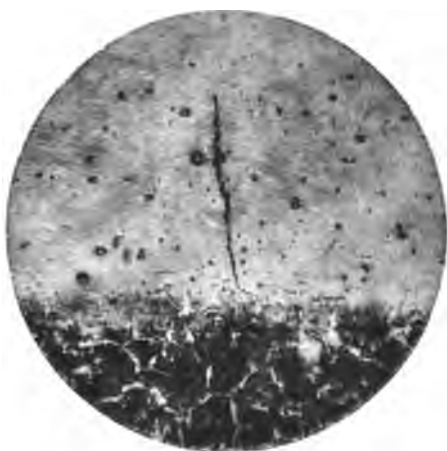


PHOTOMICROGRAPH OF THERMAL CRACK IN HEAD OF RAIL, CRACK
NOT PENETRATING BEYOND HARDENED METAL OF RUNNING
SURFACE. LONGITUDINAL SECTION OF RAIL HEAD.
MAGNIFICATION 110 DIAMETERS.

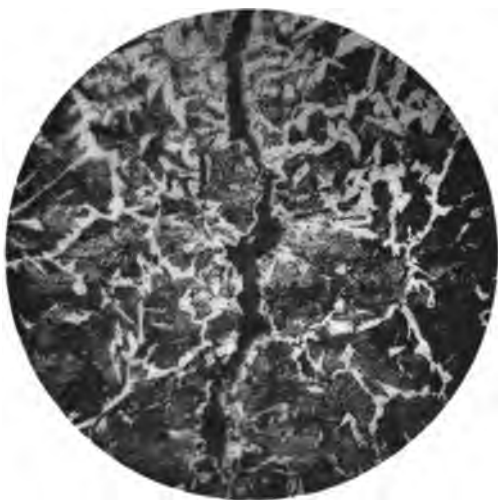


PHOTOMICROGRAPH OF THERMAL CRACK IN HEAD OF RAIL.
TRANSVERSE SECTION OF RAIL HEAD.
MAGNIFICATION 110 DIAMETERS.





PHOTOMICROGRAPH OF THERMAL CRACK IN HEAD OF RAIL,
INTERIOR CRACK, IN HARDENED ZONE OF HEAD.
TRANSVERSE SECTION OF RAIL HEAD.
MAGNIFICATION 110 DIAMETERS.

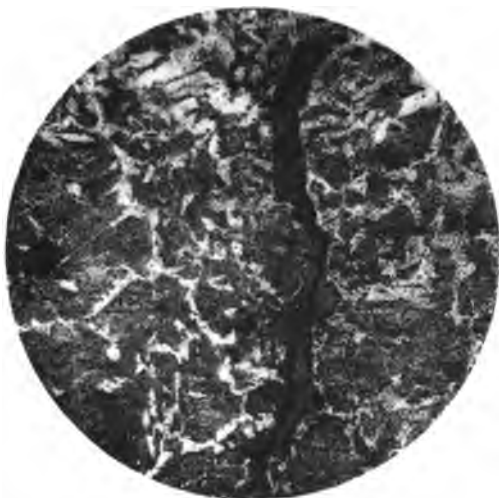


PHOTOMICROGRAPH OF STREAK IN BASE OF STEEL RAIL. INITIAL STATE.
MAGNIFICATION 150 DIAMETERS.



PHOTOMICROGRAPH OF STREAK IN BASE OF STEEL RAIL, AFTER
STRAINING. FISSURE IN STREAK OPENED.
MAGNIFICATION 150 DIAMETERS





PHOTOMICROGRAPH OF STREAK IN BASE OF STEEL RAIL, AFTER FURTHER
STRAINING. FISSURE IN STREAK INCREASED IN WIDTH.
MAGNIFICATION 150 DIAMETERS.

ENDURANCE OF ROTATING SHAFTS.

No. 405.

Marks, 1.09 C.

Gautier steel bar; 1.09 per cent carbon. Hot-rolled bar.

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				De- flec- tions.	Sets.	Remarks.
	Successive.	Total.	On line.	Un- load- ed.	Load- ed.	Un- load- ed.			
<i>Pounds.</i>				<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
35,000	.....	12, 876, 430	.....	.....	.....	.....	.....	.....	Reported in 1905.
35,000	57, 424, 290	70, 300, 720	.....	.....	.....	.....	.....	.....	Reported in 1906.
35,000	69, 599, 610	139, 900, 330	.....	.....	.....	.....	.....	.....	Reported in 1907.
35,000	35, 379, 670	175, 280, 000	a	.1563	.1277	.1562	.0285	.0001	
	.....	.....	b	.1565	.1280	.1562	.0282	.0003	
40,000	0	175, 280, 000	a	.1566	.1235	.1563	.0328	.0003	
	.....	.....	b	.1565	.1235	.1562	.0327	.0003	
40,000	1,000	175, 281, 000	a	.1565	.1237	.1563	.0326	.0002	
	.....	.....	b	.1565	.1233	.1562	.0329	.0003	
45,000	0	175, 281, 000	a	.1567	.1197	.1563	.0366	.0004	
	.....	.....	b	.1567	.1194	.1560	.0366	.0007	
45,000	1,000	175, 282, 000	a	.1566	.1190	.1557	.0367	.0009	
	.....	.....	b	.1573	.1190	.1557	.0367	.0016	
50,000	0	175, 282, 000	a	.1572	.1148	.1554	.0406	.0018	
	.....	.....	b	.1573	.1146	.1556	.0410	.0017	
50,000	1,000	175, 283, 000	a	.1567	.1125	.1543	.0418	.0024	
	.....	.....	b	.1587	.1129	.1544	.0415	.0043	
55,000	0	175, 283, 000	a	.1585	.1064	.1541	.0457	.0044	
	.....	.....	b	.1588	.1063	.1540	.0457	.0048	
55,000	1,000	175, 284, 000	a	.1620	.1041	.1512	.0471	.0108	
	.....	.....	b	.1610	.1039	.1505	.0466	.0105	
60,000	0	175, 284, 000	a	.1620	.1007	.1505	.0498	.0115	
	.....	.....	b	.1620	.1007	.1499	.0492	.0121	
60,000	1,000	175, 285, 000	a	.1565	.0847	.1385	.0538	.0180	
	.....	.....	b	.1725	.0930	.1450	.0520	.0275	
60,000	16, 350	175, 301, 350	.....	.....	.....	.....	.....	.....	Bar ruptured under one of the middle bearings.

No. 415.

Marks, AM-834-10-1.

Amorphous steel bar.

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				De- flec- tions.	Sets.	Remarks.
	Successive.	Total.	On line.	Un- load- ed.	Load- ed.	Un- load- ed.			
<i>Pounds.</i>				<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
40,000		45,386,500							Reported in 1907.
40,000	34,813,500	80,200,000	a	.1574	.1242	.1572	.0330	.0002	
			b	.1575	.1246	.1574	.0328	.0001	
45,000	0	80,200,000	a	.1573	.1203	.1572	.0369	.0001	
			b	.1575	.1206	.1573	.0367	.0002	
45,000	1,000	80,201,000	a	.1572	.1198	.1567	.0369	.0005	
			b	.1570	.1205	.1570	.0365	0.	
50,000	0	80,201,000	a	.1572	.1158	.1569	.0411	.0003	
			b	.1571	.1170	.1572	.0402	-.0001	
50,000	1,000	80,202,000	a	.1570	.1154	.1569	.0415	.0001	
			b	.1572	.1172	.1570	.0398	.0002	
55,000	0	80,202,000	a	.1572	.1120	.1570	.0450	.0002	
			b	.1573	.1138	.1570	.0432	.0003	
55,000	1,000	80,203,000	a	.1572	.1118	.1568	.0450	.0004	
			b	.1573	.1132	.1572	.0440	.0001	
60,000	0	80,203,000	a	.1573	.1077	.1567	.0490	.0006	
			b	.1571	.1094	.1572	.0478	-.0001	
60,000	1,000	80,204,000	a	.1572	.1076	.1569	.0493	.0003	
			b	.1574	.1093	.1570	.0477	.0004	
60,000	395,480	80,599,480							Bar ruptured between middle bearings.

No. 416.

Marks, SO-1-98A-11.

Sorbitic steel bar.

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflec- tions.	Sets.	Remarks.
	Successive.	Total.	On line.	Un- load- ed.	Load- ed.	Un- load- ed.			
<i>Pounds.</i>				<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
40,000		37,528,170							Reported in 1907.
40,000	34,459,830	71,985,000	a	.1595	.1260	.1592	.0332	.0003	
			b	.1577	.1245	.1575	.0030	.0002	
45,000	0	71,985,000	a	.1594	.1220	.1592	.0372	.0002	
			b	.1577	.1203	.1576	.0373	.0001	
45,000	1,000	71,986,000	a	.1594	.1216	.1592	.0376	.0002	
			b	.1575	.1202	.1573	.0371	.0002	
50,000	0	71,986,000	a	.1595	.1178	.1592	.0414	.0003	
			b	.1578	.1162	.1574	.0412	.0004	
50,000	1,000	71,987,000	a	.1594	.1178	.1591	.0413	.0003	
			b	.1578	.1164	.1574	.0410	.0004	
55,000	0	71,987,000	a	.1595	.1144	.1590	.0446	.0001	
			b	.1580	.1122	.1572	.0450	.0008	
55,000	1,000	71,988,000	a	.1590	.1135	.1589	.0454	.0001	
			b	.1578	.1110	.1569	.0459	.0009	
60,000	0	71,988,000	a	.1600	.1101	.1589	.0488	.0011	
			b	.1580	.1077	.1567	.0490	.0013	
60,000	1,000	71,989,000	a	.1604	.1090	.1588	.0498	.0016	
			b	.1580	.1062	.1560	.0498	.0020	
60,000	92,310	72,081,310							Barruptured between middle bearings.

No. 417.

Marks, .73 C.

Gautier steel bar; 0.73 per cent carbon. Hot-rolled bar.

Diameter, 1". Speed of rotation, 500 per minute.

Length between end supports, 33".

Loaded over 4" length at middle.

Deflections measured on chord of 10".

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflec- tions.	Sets.	Remarks.
	Successive.	Total.	On line.	Un- load- ed.	Load- ed.	Un- load- ed.			
<i>Pounds.</i> 40,000		24,013,050		<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	Reported in 1907.
40,000	34,386,950	58,400,000	a	.1573	.1243	.1572	.0329	.0001	
			b	.1576	.1248	.1574	.0326	.0002	
45,000	0	58,400,000	a	.1573	.1207	.1572	.0365	.0001	
			b	.1575	.1212	.1575	.0363	0.	
45,000	1,000	58,401,000	a	.1572	.1207	.1572	.0365	0.	
			b	.1577	.1209	.1574	.0365	.0003	
50,000	0	58,401,000	a	.1573	.1166	.1572	.0406	.0001	
			b	.1575	.1170	.1573	.0403	.0002	
50,000	1,000	58,402,000	a	.1572	.1162	.1568	.0406	.0004	
			b	.1580	.1163	.1573	.0410	.0007	
55,000	0	58,402,000	a	.1575	.1120	.1568	.0448	.0007	
			b	.1580	.1125	.1571	.0446	.0009	
55,000	1,000	58,403,000	a	.1587	.1109	.1562	.0453	.0025	
			b	.1586	.1108	.1563	.0455	.0023	
60,000	0	58,403,000	a	.1585	.1067	.1560	.0493	.0025	
			b	.1590	.1070	.1561	.0491	.0029	
60,000	1,000	58,404,000	a	.1537	.1035	.1533	.0498	.0004	Bar ruptured between middle bearings.
			b	.1614	.1048	.1550	.0502	.0064	
60,000	73,040	58,477,040							

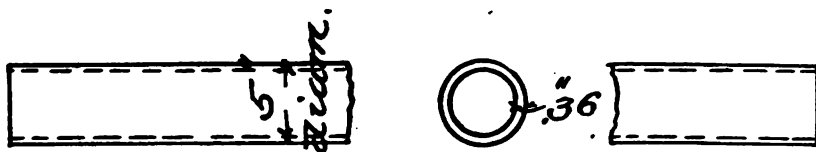


LAP WELDED STEEL TUBING.

COMPRESSION TESTS.

DIMENSIONS OF TUBING :

Nominal diameter, 5"; nominal thickness, ".36.

BESSEMER STEEL LAP WELDED TUBING.**FLAT END TESTS.**

Nominal weight, 18.22 pounds per foot.
 Nominal sectional area, 5.25 square inches.
 Radius of gyration, 1".645.

SCHEDULE OF LENGTHS.

$$1'-8\frac{1}{4}" = 12.5 \frac{L}{R}$$

$$3'-5\frac{1}{2}" = 25.0 \frac{L}{R}$$

$$5'-11\frac{1}{4}" = 37.5 \frac{L}{R}$$

$$6'-10\frac{1}{4}" = 50.0 \frac{L}{R}$$

$$8'-6\frac{1}{4}" = 62.5 \frac{L}{R}$$

$$10'-3\frac{1}{2}" = 75.0 \frac{L}{R}$$

$$13'-8\frac{1}{2}" = 100.0 \frac{L}{R}$$

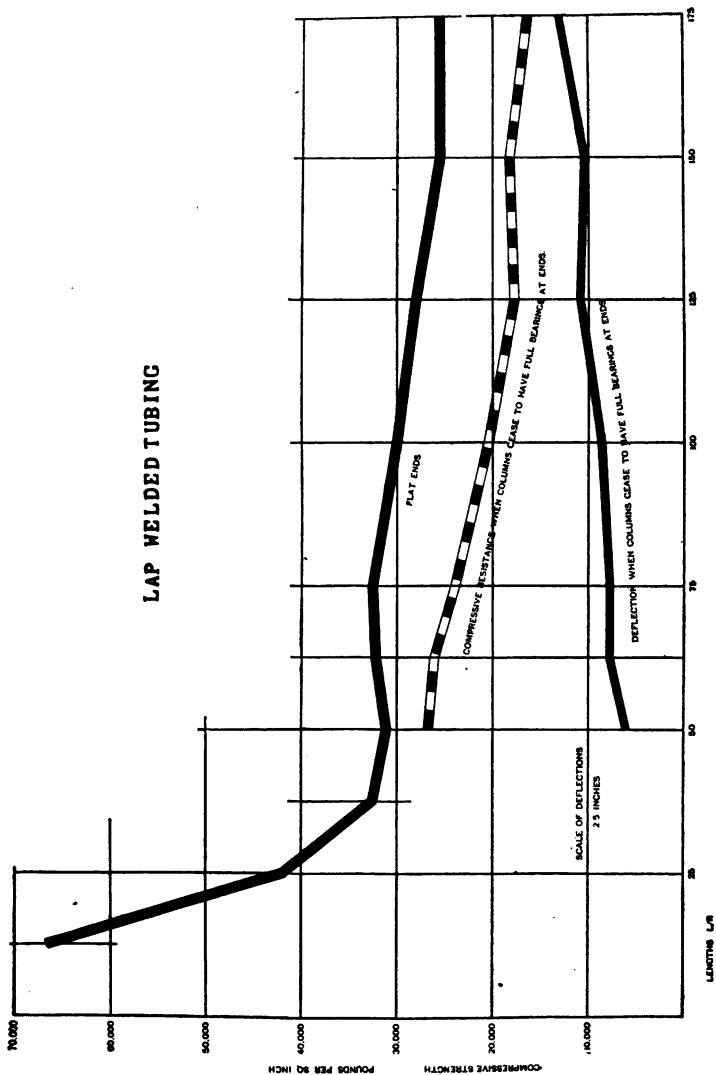
$$17'-1\frac{1}{2}" = 125.0 \frac{L}{R}$$

$$20'-6\frac{1}{4}" = 150.0 \frac{L}{R}$$

$$24'-0" = 175.0 \frac{L}{R}$$

CHEMICAL ANALYSES.

Carbon.	Manga- nese.	Silicon.	Sulphur.	Phos- phorus.
.13	.32	Trace.	.037	.063
.12	.32	Trace.	.040	.064
.11	.20	Trace.	.065	.067



Curve of compressive strength of annular sections, lap welded steel tubing, also curves showing the diminished resistance of the columns and the amount of deflections when they ceased to retain full bearings at their ends against the platforms of the testing machine.

No. 1895.

Lap welded tubing, 5" nominal diameter.

Flat ends.

Length, 1 foot 8 $\frac{1}{8}$ inches.

Weight, 30 pounds.

Sectional area, 5.15 square inches.

Thickness of tubing, ".33 to ".41.

Gauged length, 10 inches.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
5,150	1,000	0.	0.	Initial load.
25,750	5,000	.0006	.0001	
51,500	10,000	.0019	.0002	
77,250	15,000	.0035	.0002	
103,000	20,000	.0052	.0002	
128,750	25,000	.0068	.0002	
133,900	26,000	.0072	.....	
139,050	27,000	.0076	.....	
144,200	28,000	.0079	.....	
149,350	29,000	.0083	.....	
154,500	30,000	.0087	.0002	Elastic limit.
159,650	31,000	.0089	.....	
164,800	32,000	.0095	.....	
169,950	33,000	.0105	.....	
175,100	34,000	.0114	.....	
180,250	35,000	.0252	.0147	
.....	5,000	.0157	.....	
.....	10,000	.0174	.....	
.....	15,000	.0190	.....	
.....	20,000	.0204	.....	
.....	25,000	.0220	.....	
.....	20,000	.0205	.....	
.....	15,000	.0190	.....	
.....	10,000	.0175	.....	
.....	5,000	.0158	.0146	
185,400	36,000	.10		
190,550	37,000	.11	.....	
195,700	38,000	.11	.....	
200,850	39,000	.12	.....	
206,000	40,000	.15	.....	
211,150	41,000	.17	.....	
216,300	42,000	.19	.....	
221,450	43,000	.21	.....	
226,600	44,000	.23	.....	
231,750	45,000	.25	.....	
236,900	46,000	.27	.....	
242,050	47,000	.29	.....	
247,200	48,000	.31	.....	
252,350	49,000	.33	.....	
257,500	50,000	.36	.....	
262,650	51,000	.38	.....	
267,800	52,000	.40	.....	
272,950	53,000	.42	.....	
278,100	54,000	.45	.....	
283,250	55,000	.47	.....	
288,400	56,000	.49	.....	
293,550	57,000	.53	.....	
298,700	58,000	.54	.....	
303,850	59,000	.56	.....	
309,000	60,000	.60	.....	
314,150	61,000	.63	.....	
319,300	62,000	.66	.....	
324,450	63,000	.70	.....	
329,600	64,000	.73	.....	
334,750	65,000	.77	.....	
339,900	66,000	.84	.....	
345,050	67,000	.92		Ultimate strength.
		.95	.....	

Ends swelled locally, bulging outward.

Test continued until length was reduced to 17.30 inches.

Split along weld.

No. 1896.

Lap welded tubing, 5" nominal diameter.

Flat ends.

Length, 1 foot $8\frac{1}{8}$ inches.Weight, $30\frac{1}{2}$ pounds.

Sectional area, 5.24 square inches.

Thickness of tubing, ".32 to ".40.

Gauged length, 10 inches.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
5,240	1,000	0.	0.	Initial load.
26,200	5,000	.0007	0.	
52,400	10,000	.0021	0.	
78,600	15,000	.0038	.....	
104,800	20,000	.0056	.0002	
131,000	25,000	.0076	.0003	
157,200	30,000	.0098	.0004	
162,400	31,000	.0105	.....	
167,680	32,000	.0112	.....	
172,920	33,000	.0119	.....	Elastic limit.
178,160	34,000	.0135	.....	
183,400	35,000	.0302	.0192	Rapid yielding.
188,640	36,000	.09	.....	
193,880	37,000	.12	.....	
199,120	38,000	.13	.....	
204,360	39,000	.15	.....	
209,600	40,000	.16	.....	
235,800	45,000	.27	.....	
262,000	50,000	.38	.....	
288,200	55,000	.50	.....	
314,400	60,000	.63	.....	
340,600	65,000	.73	.....	
347,700	66,350	.....	.....	Ultimate strength.

Walls buckled outward near ends of specimen.

Length over all at time of maximum stress, about 18.40 inches.

No. 1897.

Lap welded tubing, 5" nominal diameter.

Flat ends.

Length, 1 foot $8\frac{3}{4}$ inches.Weight, 30 $\frac{1}{2}$ pounds.

Sectional area, 5.24 square inches.

Thickness of tubing, ".35 to ".39.

Gauged length, 10 inches.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
5,240	1,000	0.	0.	Initial load.
26,200	5,000	.0005	0.	
52,400	10,000	.0024	.0001	
78,600	15,000	.0041		
104,800	20,000	.0058	.0002	
131,000	25,000	.0075		Elastic limit.
157,200	30,000	.0092	.0002	
162,440	31,000	.0097		
167,680	32,000	.0104		
172,920	33,000	.0111		
178,160	34,000	.0127		
182,400	35,000	.0304		
188,640	36,000	.08		
193,880	37,000	.10		
199,120	38,000	.11		
204,360	39,000	.12		
209,600	40,000	.15		
235,800	45,000	.24		
262,000	50,000	.35		
288,200	55,000	.47		
314,400	60,000	.61		Ultimate strength.
340,600	65,000	.76		
346,800	66,180	.83		

Walls buckled outward near ends of specimen.

Length over all at time of maximum stress, 18.57 inches.

No. 1891.

Lap welded tubing, 5" nominal diameter.

Flat ends.

Length, 3 feet 5 inches.

Weight, 62 pounds.

Sectional area, 5.34 square inches.

Gauged length, 20 inches.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
5,340	1,000	0.	0.	Initial load.
26,700	5,000	.0025	.....	
53,400	10,000	.0064	0.	
80,100	15,000	.0097	.....	
106,800	20,000	.0132	0.	
133,500	25,000	.0169	.....	
160,200	30,000	.0205	.0005	
165,540	31,000	.0214	.....	
170,880	32,000	.0222	.....	
176,220	33,000	.0233	.....	
181,560	34,000	.0329		Ultimate strength.
222,600	41,700	.....	.....	

Under 34,000 pounds per square inch the tubing shortened to 40".54 length over all and deflected ".35 at middle of height. During a part of the time of shortening the total load dropped to about 175,000 pounds, after which, the load advanced to the maximum.

Failed by triple flexure.

The deflection was about 2".75 when the maximum load was reached.

No. 1892.

Lap welded tubing, 5" nominal diameter.

Flat ends.

Length, 3 feet 5 inches.

Weight, 61 pounds.

Sectional area, 5.25 square inches.

Gauged length, 20 inches.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
5,250	1,000	0.	0.	Initial load.
26,250	5,000	.0028	.....	
52,500	10,000	.0064	0.	
78,750	15,000	.0096	.....	
105,000	20,000	.0131	0.	
131,250	25,000	.0166		Elastic limit. Second application of load. Compression measured after load was sustained 1½ minutes. Ultimate strength.
157,500	30,000	.0223	.0028	
157,500	30,000	.1485	.....	
213,200	40,610	.....	.....	

At time of reaching the maximum load the tubing had deflected 1".60 and shortened to a length over all of 38".90. Metal bulged in vicinity of ends of tubing. Test discontinued immediately after reaching maximum stress.

Failed by triple flexure.

No. 1893.

Lap welded tubing, 5" nominal diameter.

Flat ends.

Length, 3 feet 5 inches.

Weight, 60 pounds.

Sectional area, 5.17 square inches.

Gauged length, 20 inches.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
5,170	1,000	0.	0.	Initial load.
25,850	5,000	.0026	.....	
51,700	10,000	.0065	0.	
77,550	15,000	.0098	.....	
103,400	20,000	.0135	.0003	
129,250	25,000	.0178		Elastic limit.
134,420	26,000	.0186	.....	
139,590	27,000	.0195	.....	
144,760	28,000	.0204	.....	
149,930	29,000	.0214	.....	
155,100	30,000	.0235	.0034	Ultimate strength.
160,270	31,000	.0320	.....	
206,000	39,850	.2000	.....	
				

At the time of reaching the maximum load the tubing had deflected 2".20 and shortened to a length of 39" over all.

Failed by triple flexure.

No. 1898.

Lap welded tubing, 5" nominal diameter.

Flat ends.

Length, 3 feet 5½ inches.

Weight, 59½ pounds.

Sectional area, 5.10 square inches.

Thickness of tubing, ".32 to ".36.

Gauged length, 30 inches.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
5,100	1,000	0.	0.	Initial load.
25,500	5,000	.0026	.0002	
51,000	10,000	.0011	.0002	
76,500	15,000	.0117		
102,000	20,000	.0170	.0003	
127,500	25,000	.0228	.0004	Elastic limit.
153,000	30,000	.0299	.0011	
158,100	31,000	.0319		
163,200	32,000	.0367		
168,300	33,000	.18		
173,400	34,000	.32		
178,500	35,000	.36		
183,600	36,000	.40		
188,700	37,000	.45		
193,800	38,000	.50		
198,900	39,000	.55		Ultimate strength.
204,000	40,000	.58		
209,100	41,000	.62		
214,200	42,000	.67		
224,400	44,000	.80		
234,600	46,000			

Failed by triple flexure bending upward.

Walls bulged outward near ends of tubing.

Ends left full bearing against testing machine while under the maximum load.

Weld on concave side of bend.

No. 1899.

Lap welded tubing, 5" nominal diameter.

Flat ends.

Length, 3 feet 5½ inches.

Weight, 60½ pounds.

Sectional area, 5.18 square inches.

Thickness of tubing, ".32 to ".38.

Gauged length, 30 inches.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
5,180	1,000	0.	0.	Initial load.
25,900	5,000	.0036	.0001	
51,800	10,000	.0085	.0001	
77,700	15,000	.0134	.0002	
103,600	20,000	.0185	.0002	
129,500	25,000	.0237	.0002	
155,400	30,000	.0302	.0012	
160,580	31,000	.0322	.....	Elastic limit.
165,760	32,000	.0355	.....	
170,940	33,000	.23	.....	Column began triple flexure.
176,120	34,000	.28	.....	
181,300	35,000	.33	.....	
186,480	36,000	.37	.....	
196,840	38,000	.45	.....	
207,200	40,000	.56	.....	
217,560	42,000	.70	.....	
224,100	43,260	.....	.....	Ultimate strength.

Failed by triple flexure.

Welded side on the quarter.

No. 1900.

Lap welded tubing, 5" nominal diameter.

Flat ends.

Length, 3 feet 5½ inches.

Weight, 62½ pounds.

Sectional area, 5.36 square inches.

Thickness of tubing, ".36 to ".38.

Gauged length, 30 inches.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inches.</i>	<i>Inch.</i>	
5,360	1,000	0.	0.	Initial load.
26,800	5,000	.0027	0.	
53,600	10,000	.0074	0.	
80,400	15,000	.0120	0.	
107,200	20,000	.0170	.0005	Elastic limit.
134,000	25,000	.0228		
155,400	29,000	.0311		
160,800	30,000	.0528		
166,160	31,000	.1380		
171,520	32,000	.28		
176,880	33,000	.35		
182,240	34,000	.41		
192,960	36,000	.46		
203,680	38,000	.62		
214,400	40,000	.78		
219,400	40,930	1.05		
222,000	41,420			
				Ends left full bearing against testing machine.
				Ultimate strength.

Failed by triple flexure.

No. 1901.

Lap welded tubing, 5" nominal diameter.

Flat ends.

Length, 5 feet 1 $\frac{1}{4}$ inches.Weight, 88 $\frac{1}{2}$ pounds.

Sectional area, 5.06 square inches.

Thickness of tubing, ".32 to ".37.

Gauged length, 30 inches.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
5,060	1,000	0.	0.	Initial load.
25,300	5,000	.0035	0.	
50,600	10,000	.0084	0.	
75,900	15,000	.0133	.....	
101,200	20,000	.0187	.0001	
126,500	25,000	.0234	.0003	
131,560	26,000	.0248	.....	
136,620	27,000	.0259	.....	
141,680	28,000	.0270	.....	
146,740	29,000	.0283	.....	
151,800	30,000	.0298	.0012	Elastic limit.
156,860	31,000	.0311	.....	
161,920	32,000	.0327	.....	
166,980	33,000	.0349	.....	
172,040	34,000	.135		Ultimate strength.

Failed by triple flexure.

Deflected downward.

No. 1902.

Lap welded tubing, 5" nominal diameter.

Flat ends.

Length, 5 feet, 11 $\frac{1}{4}$ inches.

Weight, 91 $\frac{1}{2}$ pounds.

Sectional area, 5.23 square inches.

Thickness of tubing, ".36 to ".37.

Gauged length, 30 inches.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
5,230	1,000	0.	0.	Initial load.
26,150	5,000	.0036	0.	
52,300	10,000	.0086	.0001	
78,450	15,000	.0134		
104,600	20,000	.0183	.0002	
130,750	25,000	.0236	.0002	
135,980	26,000	.0248		Elastic limit.
141,210	27,000	.0258		
146,440	28,000	.0269		
151,670	29,000	.0280		
156,900	30,000	.0291	.0005	
162,130	31,000	.0328		Ultimate strength.
167,360	32,000	.0360		
		.0670		

Failed by triple flexure, upward and horizontally.

No. 1903.

Lap welded tubing, 5" nominal diameter.

Flat ends.

Length, 5 feet, 1 $\frac{1}{4}$ inches.Weight, 93 $\frac{1}{2}$ pounds.

Sectional area, 5.34 square inches.

Thickness of tubing, ".35 to ".37.

Gauged length, 30 inches.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
5,340	1,000	0.	0.	Initial load.
26,700	5,000	.0034	0.	
53,400	10,000	.0084	0.	
80,100	15,000	.0131	.....	
106,800	20,000	.0184	.0003	
133,500	25,000	.0244	.0011	Elastic limit.
138,840	26,000	.0264	.....	
144,180	27,000	.0278	.....	
149,520	28,000	.0302	.....	
154,860	29,000	.0335	.....	
160,200	30,000	.0405		Ultimate strength.
169,500	31,740	.....	.....	

Failed by triple flexure, deflecting upward at middle of length.

No. 1888.

Lap welded tubing, 5" nominal diameter.

Flat ends.

Length, 6 feet, 10½ inches.

Weight, 122 pounds.

Sectional area, 5.24 square inches.

Initial deflection; horizontal, ".11, vertical, ".03.

Gauged length, 50 inches.

Applied loads.		In gauged length.		Deflections at middle.		Remarks.
Total.	Pounds per square inch.	Com- pression.	Set.	Hori- zontal.	Vertical.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inches.</i>	<i>Inch.</i>	
5,240	1,000	0.	0.	0.	0.	Initial load.
26,200	5,000	.0066	.....	0.	0.	
52,400	10,000	.0151	.0002	0.	0.	
.....	1,000	.....	.....	0.	0.	
78,600	15,000	.0237	.....	0.	.01	
104,800	20,000	.0322	.0004	0.	.01	Ultimate strength.
.....	1,000	.....	.....	0.	0.	
131,000	25,000	.0408	.....	.01	.01	
151,000	28,820	.....	.....	.10	-.03	
.....						
130,000	24,810			1.11	-.48	Load and deflections when ends left full bearing against plat-forms of testing machine.

Failed by triple flexure.

No. 1889.

Lap welded tubing, 5" nominal diameter.

Flat ends.

Length, 6 feet, 10½ inches.

Weight, 121 pounds.

Sectional area, 5.19 square inches.

Initial deflection; horizontal, ".08. vertical, ".04.

Gauged length, 50 inches.

Applied loads.		In gauged length.		Deflections at middle		Remarks.
Total.	Per square inch.	Compression.	Set.	Horizontal.	Vertical.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inches.</i>	<i>Inch.</i>	
5,190	1,000	0.	0.	0.	0.	Initial load.
25,950	5,000	.0067	-----	0.	0.	
51,900	10,000	.0156	-----	.01	0.	
-----	1,000	-----	0.	0.	0.	
77,850	15,000	.0241	-----	.01	0.	
103,800	20,000	.0329	-----	.01	0.	
-----	1,000	-----	.0003	0.	0.	
129,750	25,000	.0426	-----	.01	0.	
-----	1,000	-----	.0014	.01	0.	
134,940	26,000	.0449	-----	.01	0.	
140,130	27,000	.0473	-----	.01	.01	Micrometer disturbed.
145,320	28,000	.0498	-----	.01	.01	
-----	1,000	-----	-----	0.	.01	
150,510	29,000	.0520	-----	.01	.01	
155,700	30,000	.0557	-----	.02	.01	
-----	1,000	-----	.0059	.01	0.	
160,890	31,000	.0608	-----	.02	.01	
166,080	32,000	.0685	-----	.04	.01	
-----	-----	-----	-----	.13	.04	
146,000	28,130	-----	-----	1.75	.29	Ultimate strength.
						Load and deflections when ends left full bearing against plat-forms of the testing machine.

Failed by triple flexure.

No. 1890.

Lap welded tubing, 5" nominal diameter.

Flat ends.

Length, 6 feet, 10 $\frac{1}{4}$ inches.

Weight, 121.5 pounds.

Sectional area, 5.21 square inches.

Initial deflection; horizontal, ".06, vertical, ".02.

Gauged length, 50 inches.

Applied loads.		In gauged length.		Deflections at middle.		Remarks.
Total.	Per square inch.	Compression.	Set.	Horizontal.	Vertical.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inches.</i>	<i>Inch.</i>	Initial load.
5,210	1,000	0.	0.	0.	0.	
26,050	5,000	.0067	.....	8.	0.	
52,100	10,000	.0159	.....	0.	0.	
.....	1,000	.....	0.	0.	0.	
78,150	15,000	.0242	.....	0.	0.	
104,200	20,000	.0336	.....	0.	0.	
.....	1,000	.....	.0012	0.	0.	
130,250	25,000	.0444	.....	0.	0.	
.....	1,000	.....	.0034	0.	0.	
156,300	30,000	.0578		.01	0.	Ultimate strength.
.....	1,000	.....	.0090	.01	0.	
161,510	31,000	.0629	.....	.01	.01	
.....	.....	.0777	.....	.01	.01	
166,720	32,000	.0897	.....	.00	.02	
.....	.....	.....	.....	— .12	.08	
143,000	27,450			—1.44	.63	Load and deflections when ends left full bearing against platforms of testing machine.

Failed by triple flexure.

No. 1904.

Lap welded tubing, 5" nominal diameter.

Flat ends.

Length, 6 feet 10½ inches.

Weight, 124½ pounds.

Sectional area, 5.33 square inches.

Thickness of tubing, ".35 to ".37.

Gauged length, 50 inches.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
5,330	1,000	0.	0.	Initial load.
26,650	5,000	.0060	0.	
53,300	10,000	.0143	.0001	
79,950	15,000	.0228	.....	
106,600	20,000	.0313	.0004	
133,250	25,000	.0400	.0013	
138,580	26,000	.0423	.....	
143,910	27,000	.0444	.....	
149,240	28,000	.0471	.....	Elastic limit.
154,570	29,000	.0525	.....	
159,900	30,000	.1320		Ultimate strength.

Failed by triple flexure, deflecting downward at middle of length.

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No. 1905.

Lap welded tubing, 5" nominal diameter.

Flat ends.

Length, 6 feet 10½ inches.

Weight, 118 pounds.

Sectional area, 5.06 square inches.

Thickness of tubing, ".32 to ".36.

Gauged length, 50 inches.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
5,060	1,000	0.	0.	Initial load.
25,300	5,000	.0065	0.	
50,600	10,000	.0149	.0001	
75,900	15,000	.0235	.....	
101,200	20,000	.0321	.0003	
126,500	25,000	.0406	.0008	
131,560	26,000	.0425	.....	
136,620	27,000	.0443	.....	
141,680	28,000	.0463	.....	
146,740	29,000	.0483	.....	
151,800	30,000	.0506	.0020	Elastic limit.
156,860	31,000	.0528	.....	
161,920	32,000	.0552		Ultimate strength.
		.1420	.....	

Failed by triple flexure, deflecting sidewise at middle of length.

No. 1906.

Lap welded tubing, 5" nominal diameter.

Flat ends.

Length, 6 feet 10½ inches.

Weight, 122½ pounds.

Sectional area, 5.25 square inches.

Thickness of tubing, ".33 to ".36.

Gauged length, 50 inches.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
5,250	1,000	0.	0.	Initial load.
26,250	5,000	.0065	0.	
52,500	10,000	.0146	.0003	
78,750	15,000	.0232	.....	
105,000	20,000	.0315	.0006	
131,250	25,000	.0398	.0010	
136,500	26,000	.0417	.....	
141,750	27,000	.0434	.....	
147,000	28,000	.0455	.....	
152,250	29,000	.0478	.....	
157,500	30,000	.0513	.0035	Elastic limit.
162,750	31,000	.0552		Rapid scaling near ends.
168,000	32,000			Ultimate strength.

Failed by triple flexure, deflecting upward at middle of length.

No. 1907.

Lap welded tubing, 5" nominal diameter.

Flat ends.

Length, 8 feet 6 $\frac{1}{4}$ inches.Weight, 151 $\frac{1}{2}$ pounds.

Sectional area, 5.20 square inches.

Thickness of tubing, ".32 to ".36.

Gauged length, 50 inches.

Counterweighted at middle.

Applied loads.		In gauged length.		Deflections at middle.		Remarks.
Total.	Per square inch.	Compression.	Set.	Horizontal.	Vertical.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inches.</i>	<i>Inches.</i>	
5,200	1,000	0.	0.	0.	0.	Initial load.
26,000	5,000	.0060	— .0003	0.	0.	
	1,000			0.	0.	
52,000	10,000	.0147	— .0003	0.	0.	
	1,000			0.	0.	
78,000	15,000	.0231	— .0002	0.	0.	
104,000	20,000	.0318		0.	0.	
	1,000			0.	0.	
130,000	25,000	.0404	+ .0002	0.	0.	
	1,000			0.	0.	
135,200	26,000	.0425		0.	0.	
140,400	27,000	.0441		0.	0.	
145,600	28,000	.0459		0.	0.	
150,800	29,000	.0480		0.	0.	
156,000	30,000	.0501		0.	0.	
	1,000		.0012	0.	0.	Elastic limit.
161,200	31,000	.0522		0.	0.	
166,400	32,000	.0543		.01	0.	
171,600	33,000	.0573		.02	0.	
		.0588		.03	0.	
176,800	34,000	.0610		.03	0.	After 2 minutes.
		.0630		.04	.01	
182,000	35,000	.0674		.04	.01	After 2 minutes.
185,300	35,630	.0840		.14	.07	
						Ultimate strength.
142,000	27,310			1.70	1.27	Load and deflections when ends left full bearing against the platforms of testing machine.

Failed by triple flexure, deflecting downward and sidewise.

No. 1908.

Lap welded tubing, 5" nominal diameter.

Flat ends.

Length, 8 feet 6 $\frac{1}{8}$ inches.

Weight, 148 pounds.

Sectional area, 5.08 square inches.

Thickness of tubing, ".32 to ".42.

Gauged length, 50 inches.

Counterweighted at middle.

Applied loads.		In gauged lengths.		Deflections at middle.		Remarks.
Total.	Per square inch.	Compression.	Set.	Horizontal.	Vertical.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inches.</i>	<i>Inch.</i>	
5,080	1,000	0.	0.	0.	0.	Initial load.
25,400	5,000	.0060	0.	0.	0.	
	1,000		0.	0.	0.	
50,800	10,000	.0140	0.	0.	0.	
	1,000		0.	0.	0.	
76,200	15,000	.0225		0.	.01	
101,600	20,000	.0308		0.	.01	
	1,000		.0001	0.	0.	
127,000	25,000	.0395		0.	.01	
	1,000		.0012	0.	0.	
132,080	26,000	.0417		0.	.01	
137,160	27,000	.0438		0.	.01	
142,240	28,000	.0463		0.	.01	
147,320	29,000	.0491		0.	0.	
152,400	30,000	.0523		0.	0.	
	1,000		.0055	0.	0.	Ultimate strength.
157,480	31,000	.0583		.01	— .01	
		.0970		.28	— .10	
130,000	25,580			1.60	— .48	Load and deflections when ends left full bearing against the platforms of testing machine.

Failed by triple flexure, deflecting sidewise and downward.

No. 1909.

Lap welded tubing, 5" nominal diameter.

Flat ends.

Length, 8 feet 6 $\frac{1}{4}$ inches.

Weight, 153 pounds.

Sectional area, 5.26 square inches.

Thickness of tubing, ".34 to ".39.

Gauged length, 50 inches.

Counterweighted at middle.

Applied loads.		In gauged length.		Deflections at middle.		Remarks.
Total.	Per square inch.	Compression.	Set.	Horizontal.	Vertical.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inches.</i>	Initial load.
5,260	1,000	0.	0.	0.	0.	
26,300	5,000	.0063	0.	0.	0.	
	1,000	0.	0.	0.	0.	
52,600	10,000	.0144	0.	0.	0.	
	1,000	0.	0.	0.	0.	
78,900	15,000	.0232	0.	0.	0.	
105,200	20,000	.0317	0.	0.	0.	
	1,000	0.	0.	0.	0.	
131,500	25,000	.0403	0.	0.	0.	
	1,000	0.	.0006	0.	0.	
136,760	26,000	.0420	0.	0.	0.	
142,020	27,000	.0444	0.	0.	0.	
147,280	28,000	.0466	0.	0.	0.	
152,540	29,000	.0489	0.	0.	0.	Elastic limit.
157,800	30,000	.0501	0.	0.	0.	After 3 minutes.
157,800	30,000	.0530	0.	.02	0.	Ultimate strength.
	1,000	0.	.0039	.01	0.	
		.0544	0.	.02	0.	Immediate readings when reloaded.
157,800	30,000	.0616	0.	.01	.01	After 3 minutes.
		.0751	0.	0.	.04	After 10 minutes.
		.1150	0.	-.03	.17	After 15 minutes.
134,000	25,480	0.	0.	-.43	1.97	Load and deflections when ends left full bearing against platforms of the testing machine.

Failed by triple flexure. Deflected downward and sidewise at middle.

No. 1894.

Lap welded tubing, 5" nominal diameter.

Flat ends.

Length, 10 feet $\frac{1}{2}$ inch.

Weight, 176 pounds.

Sectional area, 5.16 square inches.

Thickness of tubing, ".34 to ".36.

Initial deflection; horizontal, ".13; vertical, ".03.

Gauged length, 50 inches.

Counterweighted at middle.

Applied loads.		In gauged length.		Deflections at middle.		Remarks.
Total.	Per square inch.	Compression.	Set.	Horizontal.	Vertical.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inches.</i>	<i>Inch.</i>	
5,160	1,000	0.	0.	0.	0.	Initial load.
25,800	5,000	.0064	.....	0.	0.	
51,600	10,000	.0148	.....	.01	0.	
.....	1,000	.....	0.	0.	0.	
77,400	15,000	.0229	.....	0.	0.	
103,200	20,000	.0339	.....	0.	0.	
.....	1,000	.....	.0005	0.	0.	
129,000	25,000	.0411	.....	0.	.01	
.....	1,000	.....	.0016	0.	0.	
154,800	30,000	.0524	.....	.02	.02	
.....	1,000		.0051	.01	0.	Ultimate strength.
159,960	31,000	.0549	.....	.03	.02	
165,120	32,000	.0585	.....	.04	.02	
170,280	33,000	.0695	.....	.07	.00	
.....	.....	.....	.....	.47	.00	
150,000	29,070			.99	— .10	Ends left full bearing.
140,000	27,130	.....	.....	1.60	— .15	
131,000	25,390					

No. 1885.

Lap welded tubing, 5" nominal diameter.

Flat ends.

Length, 10 feet 3½ inches.

Weight, 183 pounds.

Sectional area, 5.23 square inches.

Initial deflection; horizontal, ".02; vertical, ".04.

Gauged length, 50 inches.

Counterweighted at middle.

Applied loads.		In gauged length.		Deflections at middle.		Remarks.
Total.	Per square inch.	Compression.	Set.	Horizontal.	Vertical.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inches.</i>	<i>Inches.</i>	Initial load.
5,230	1,000	0.	0.	0.	0.	
26,150	5,000	.0067	-----	0.	.01	
52,300	10,000	.0154	-----	0.	.02	
-----	1,000	-----	0.	0.	0.	
78,450	15,000	.0239	-----	0.	.02	
104,600	20,000	.0325	-----	.01	.02	
-----	1,000	-----	.0004	0.	0.	
130,750	25,000	.0414	-----	.01	.02	
-----	1,000	-----	.0014	0.	0.	
156,900	30,000	.0525	-----	.02	.02	Ultimate strength.
-----	1,000	-----	.0041	.01	0.	
182,130	31,000	.0550	-----	.03	.03	
187,360	32,000	.0571	-----	.06	.06	
172,590	33,000	.0596	-----	.06	.09	
127,000	24,280	-----	-----	1.51	1.58	Loads and deflections when ends left full bearing against platforms of testing machine.

Failed by triple flexure.

No. 1886.

Lap welded tubing, 5" nominal diameter.

Flat ends.

Length, 10 feet 3½ inches.

Weight, 181½ pounds.

Sectional area, 5.19 square inches.

Initial deflection; horizontal, ".04; vertical, ".04.

Gauged length, 50 inches.

Counterweighted at middle.

Applied loads.		In gauged length.		Deflections at middle.		Remarks.
Total.	Per square inch.	Compression.	Set.	Horizontal.	Vertical.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inches.</i>	<i>Inch.</i>	
5,190	1,000	0.	0.	0.	0.	Initial load.
25,950	5,000	.0070	-----	0.	.01	
51,900	10,000	.0180	-----	0.	.01	
-----	1,000	-----	.0002	0.	0.	
77,850	15,000	.0247	-----	0.	.02	
103,800	20,000	.0331	-----	0.	.02	
-----	1,000	-----	.0003	0.	0.	
129,750	25,000	.0415	-----	.01	.02	
155,700	30,000	.0515	-----	.01	.02	
-----	1,000	-----	.0020	0.	0.	
160,890	31,000	.0544	-----	.02	.02	Ultimate strength.
166,080	32,000	.0574	-----	.03	.02	
171,270	33,000	.0630	-----	.11	.04	
124,000	23,890	-----	-----	2.28	.73	

Load and deflections when ends left full bearing against platforms of the testing machine.

Failed by triple flexure.

No. 1887.

Lap welded tubing, 5" nominal diameter.

Flat ends.

Length, 10 feet 3½ inches.

Weight, 182 pounds.

Sectional area, 5.20 square inches.

Initial deflection; horizontal, 0, vertical, ".08.

Gauged length, 50 inches.

Counterweighted at middle.

Applied loads.		In gauged length.		Deflections at middle.		Remarks.
Total.	Per square inch.	Compression.	Set.	Horizontal.	Vertical.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inches.</i>	
5,200	1,000	0.	0.	0.	0.	Initial load.
26,000	5,000	.0066	.....	0.	.01	
52,000	10,000	.0162	.....	.01	.02	
.....	1,000	.....	0.	0.	0.	
78,000	15,000	.0252	.....	.01	.02	
104,000	20,000	.0345		.01	.02	
.....	1,000	.....	.0007	0.	0.	
130,000	25,000	.0451	.....	.01	.02	
156,000	30,000	.0615	.....	.01	— .03	
.....	1,000	.....	.0019	0.	— .02	
161,200	31,000	.0691		.01	— .05	} Ultimate strength.
.....	.....	.....	.....	.05	— .40	
123,000	23,650			.58	—1.82	Load and deflections when ends left full bearing against platforms of testing machine.

Failed by triple flexure.

No. 1882.

Lap-welded tubing, 5" nominal diameter.

Flat ends.

Length, 13 feet 8½ inches.

Weight, 245 pounds.

Sectional area, 5.26 square inches.

Initial deflection; horizontal, ".08, vertical, ".08.

Gauged length, 100 inches.

Counterweighted at middle.

Applied loads.		In gauged length.		Deflections at middle.		Remarks.
Total.	Per square inch.	Compression.	Set.	Horizontal.	Vertical.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inches.</i>	<i>Inches.</i>	
5,260	1,000	0.	0.	0.	0.	Initial load.
26,300	5,000	.0133	.....	0.	.01	
52,600	10,000	.0308	.....	0.	.02	
.....	1,000	.....	0.	0.	0.	
78,900	15,000	.0477	.....	0.	.03	
105,200	20,000	.0651	.....	0.	.03	
.....	1,000	.....	.0009	0.	0.	
131,500	25,000	.0846	.....	.01	.03	
.....	1,000	.....	.0036	.01	.01	
136,760	26,000	.0887	.....	.02	.03	
142,020	27,000	.0932	.....	.02	.03	
147,280	28,000	.0975	.....	.02	.03	
152,540	29,000	.1029	.....	.02	.03	
157,800	30,000	.1085	.....	.03	.04	
.....	1,000	.....	.0111	.03	.02	
163,060	31,000	.1180		.08	.08	Ultimate strength.
110,000	20,910			1.79	1.15	Load and deflections when ends left full bearing against the platforms of testing machine.

Failed by triple flexure.

No. 1883.

Lap welded tubing, 5" nominal diameter.

Flat ends.

Length, 13 feet 8½ inches.

Weight, 243 pounds.

Sectional area, 5.21 square inches.

Initial deflection; horizontal, 0, vertical, ".06.

Gauged length, 100 inches.

Counterweighted at middle.

Applied loads.		In gauged length.		Deflections at middle		Remarks.
Total.	Per square inch.	Compression.	Set.	Horizontal.	Vertical.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inches.</i>	<i>Inch.</i>	Initial load.
5,210	1,000	0.	0.	0.	0.	
26,050	5,000	.0142	-----	0.	.01	
52,100	10,000	.0318	-----	0.	.02	
-----	1,000	-----	.0012	0.	0.	
78,150	15,000	.0490	-----	0.	.02	
104,200	20,000	.0660	-----	0.	.02	
-----	1,000	-----	.0017	0.	0.	
130,250	25,000	.0850	-----	.02	.03	
-----	1,000	-----	.0040	0.	.01	
135,460	26,000	.0890	-----	.03	.04	Ultimate strength.
140,670	27,000	.0945	-----	.04	.04	
145,880	28,000	.1090	-----	.12	.01	
98,000	18,810	-----	-----	2.32	— .51	

Load and deflections when ends left full bearing against plat-forms of the testing machine.

Failed by triple flexure.

No. 1884.

Lap welded tubing, 5" nominal diameter.

Flat ends.

Length, 13 feet 8½ inches.

Weight, 241 pounds.

Sectional area, 5.17 square inches.

Initial deflection; horizontal, 0, vertical 0.

Gauged length, 100 inches.

Counterweighted at middle.

Applied loads.		In gauged length.		Deflections at middle.		Remarks.
Total.	Per square inch.	Com- pression.	Set.	Hor- izontal.	Vertical.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inches.</i>	<i>Inches.</i>	
8,170	1,000	0.	0.	0.	0.	Initial load.
25,850	5,000	.0145	.....	0.	.01	
51,700	10,000	.0328	.....	.01	.01	
.....	1,000	.....	.0010	0.	0.	
77,550	15,000	.0499	.....	.01	.01	
103,400	20,000	.0673	.....	.01	.01	
.....	1,000	.....	.0013	0.	0.	
129,250	25,000	.0849	.....	.01	.01	
.....	1,000	.....	.0024	0.	0.	
134,420	26,000	.0887	.....	.01	.01	
139,590	27,000	.0929	.....	.01	.01	
144,760	28,000	.0975	.....	.01	.01	
149,930	29,000	.1031	.....	0.	0.	
155,100	30,000	.1107	.....	0.	— .02	
.....	1,000	.....	.0115	— .01	— .02	
160,270	31,000	.1265		— .06	— .11	Ultimate strength.
112,000	21,660			—1.31	—1.60	Load and deflections when ends left full bearing against plat- forms of the testing machine.

Failed by triple flexure.

No. 1879.

Lap welded tubing, 5" nominal diameter.

Flat ends.

Length, 17 feet 1½ inches.

Weight, 303 pounds.

Sectional area, 5.21 square inches.

Initial deflection; horizontal, ".12; vertical, ".04.

Gauged length, 100 inches.

Counterweighted at middle.

Applied loads.		In gauged length.		Deflections at middle.		Remarks.
Total.	Per square inch.	Compression.	Set.	Horizontal.	Vertical.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inches.</i>	<i>Inches.</i>	
5,210	1,000	0.	0.	0.	0.	Initial load.
26,050	5,000	.0137	.....	0.	.03	
52,100	10,000	.0312	.....	0.	.05	
.....	1,000	.....	.0008	0.	0.	
78,150	15,000	.0483	.....	.02	.05	
104,200	20,000	.0660	.....	.03	.06	
.....	1,000	.....	.0020	.01	.02	
130,250	25,000	.0840	.....	.05	.08	
.....	1,000	.....	.0038	.03	.05	
135,460	26,000	.0878	.....	.06	.09	
140,670	27,000	.0917	.....	.07	.09	
145,880	28,000	.0958	.....	.08	.12	
151,090	29,000	.0989	.....	.12	.22	Ultimate strength.
95,000	18,230	.....	.....	1.80	2.17	Load and deflections when ends left full bearing against platforms of the testing machine.

Failed by triple flexure.

No. 1880.

Lap welded tubing, 5" nominal diameter.

Flat ends.

Length, 17 feet 1½ inches.

Weight, 295 pounds.

Sectional area, 5.07 square inches.

Initial deflection; horizontal, wavy; vertical, ".15.

Gauged length, 100 inches.

Counterweighted at middle.

Applied loads.		In gauged length.		Deflections at middle.		Remarks.
Total.	Per square inch.	Compression.	Set.	Horizontal.	Vertical.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inches.</i>	<i>Inches.</i>	
5,070	1,000	0.	0.	0.	0.	Initial load.
25,350	5,000	.0140	.....	0.	.01	
50,700	10,000	.0311	.....	.01	.03	
.....	1,000	.....	.0005	0.	0.	
76,050	15,000	.0482	.....	.02	.04	
101,400	20,000	.0646	.....	.03	.05	
.....	1,000	.....	.0017	0.	.01	
126,750	25,000	.0831	.....	.06	.08	
.....	1,000	.....	.0048	.01	.02	
131,820	26,000	.0875	.....	.11	.12	
132,000	26,030	.....	.....	.32	.39	Ultimate strength.
86,000	16,960	.....	.....	2.27	1.67	Load and deflections when ends left full bearing against plat-forms of testing machine.

Failed by triple flexure.

No. 1881.

Lap-welded tubing, 5" nominal diameter.

Flat ends.

Length, 17 feet 1½ inches.

Weight, 303 pounds.

Sectional area, 5.21 square inches.

Initial deflection; horizontal, ".09; vertical, ".03.

Gauged length, 100 inches.

Counterweighted at middle.

Applied loads.		In gauged length.		Deflections at middle.		Remarks.
Total.	Per square inch.	Compression.	Set.	Horizontal.	Vertical.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inches.</i>	<i>Inches.</i>	
5,210	1,000	0.	0.	0.	0.	Initial load.
26,060	5,000	.0148	.....	0.	0.	
52,100	10,000	.0331	.....	.01	0.	
.....	1,000	.....	.0007	0.	0.	
78,150	15,000	.0509	.....	.01	.01	
104,200	20,000	.0685	.....	.02	.02	
.....	1,000	.....	.0014	0.	0.	
130,250	25,000	.0874	.....	.03	.03	
.....	1,000	.....	.0034	.01	.01	
135,460	26,000	.0925	.....	.04	.04	
140,670	27,000	.0966		.05	.04	Ultimate strength.
145,880	28,000	.1023	.....	.07	.05	
151,090	29,000	.1151	.....	.23	.10	
94,000	18,040	.....	.....	2.04	1.73	

Failed by triple flexure, deflections following the directions of the initial bends.

No. 1876.

Lap welded tubing, 5" nominal diameter.

Flat ends.

Length, 20 feet 6½ inches.

Weight, 357 pounds.

Sectional area, 5.11 square inches.

Initial deflection; horizontal, ".10±; vertical, 0.

Gauged length, 100 inches.

Counterweighted at middle.

Applied loads.		In gauged length.		Deflections at middle.		Remarks.
Total.	Per square inch.	Compression.	Set.	Horizontal.	Vertical.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
5,110	1,000	0.	0.	0.	0.	
25,550	5,000	.0150	.....	0.	.01	
51,100	10,000	.0330	.....	.01	.01	
.....	1,000	.....	.0008	0.	0.	
76,650	15,000	.0502	.....	.04	.02	
102,200	20,000	.0674	.....	.06	.02	
.....	1,000	.....	.0011	.01	0.	
107,310	21,000	.0707	.....	.09	.02	
112,420	22,000	.0738	.....	.10	.03	
117,530	23,000	.0772	.....	.11	.03	
122,640	24,000	.0807	.....	.13	.04	
127,750	25,000	.0840	.....	.15	.04	
.....	1,000		.0015	.02	0.	
132,860	26,000	.0890		.23	.05	Ultimate strength.

Failed by triple flexure.

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No. 1877.

Lap-welded tubing, 5" nominal diameter.

Flat ends.

Length, 20 feet 6½ inches.

Weight, 361½ pounds.

Sectional area, 5.17 square inches.

Initial deflection; horizontal, wavy; vertical, ".11.

Gauged length, 100 inches.

Counterweighted at middle.

Applied loads.		In gauged length.		Deflections at middle.		Remarks.
Total.	Per square inch.	Compression.	Set.	Horizontal.	Vertical.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inches.</i>	<i>Inch.</i>	Initial load.
5,170	1,000	0.	0.	0.	0.	
25,850	5,000	.0137	.....	0.	0.	
51,700	10,000	.0312	.....	.01	.01	
.....	1,000	.....	.0002	0.	0.	
77,550	15,000	.0487	.....	.05	.03	
103,400	20,000	.0657	.....	.08	.04	
.....	1,000	.....	.0014	0.	0.	
108,570	21,000	.0693	.....	.08	.05	
113,740	22,000	.0723	.....	.08	.05	
118,910	23,000	.0759	.....	.08	.05	
124,080	24,000	.0798	.....	.09	.05	
129,250	25,000	.0839	.....	.10	.05	
.....	1,000	.....	.0038	.02	0.	
134,420	26,000	.0885	.....	.14	.05	
139,590	27,000	.0950	.....	.22	.05	
.....				1.20		Ultimate strength.
94,000	18,200			2.60	.08	Load and deflections when ends left full bearing against platform of testing machine.

Failed by triple flexure.

No. 1878.

Lap-welded tubing, 5" nominal diameter.

Flat ends.

Length, 20 feet 6½ inches.

Weight, 360½ pounds.

Sectional area, 5.16 square inches.

Initial deflection; horizontal, ".09; vertical, ".14.

Gauged length, 100 inches.

Counterweighted at middle.

Applied loads.		In gauged lengths.		Deflections at middle.		Remarks.
Total.	Per square inch.	Compression.	Set.	Horizontal.	Vertical.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
5,160	1,000	0.	0.	0.	0.	Initial load.
25,800	5,000	.0134	.....	.01	.07	
51,600	10,000	.0307	.....	.01	.09	
.....	1,000	.....	.0013	0.	.02	
77,400	15,000	.0470	.....	.02	.15	
103,200	20,000	.0616		.03	.23	Ultimate strength.
.....	1,000	.....	.0020	0.	.06	
108,360	21,000	.0635	.....	.03	.27	
113,520	22,000	.0664	.....	.04	.31	
118,680	23,000	.....	.....	.06	.45	

Failed by triple flexure. Middle deflections followed the initial bend.

No. 1873.

Lap-welded tubing, 5" nominal diameter.

Flat ends.

Length, 24 feet 0 inches.

Weight, 411 pounds.

Sectional area, 5.04 square inches.

Thickness of tubing, ".32 to ".35.

Initial deflection; horizontal, ".10; vertical, ".24.

Gauged length, 100 inches.

Counterweighted at middle.

Applied loads.		In gauged length.		Deflections at middle.		Remarks.
Total.	Per square inch.	Compression.	Set.	Horizontal.	Vertical.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
5,040	1,000	0.	0.	0.	0.	Initial load.
25,200	5,000	.0147	-----	0.	.02	
50,400	10,000	.0324	-----	.02	.07	
-----	1,000	-----	.0018	0.	0.	
75,600	15,000	.0492	-----	.03	.11	
100,800	20,000	.0655	-----	.05	.20	Ultimate strength.
-----	1,000	-----	.0034	0.	.03	
126,000	25,000	-----	-----	-----	-----	

Rapid deflection occurred with loss in resistance when maximum load was reached. Tubing failed by triple flexure, deflecting obliquely upward and horizontally. The tubing changed its horizontal direction when the maximum load was passed, taking the opposite direction to the initial bend. The vertical deflection followed the original direction.

No. 1874.

Lap-welded tubing, 5" nominal diameter.

Flat ends.

Length, 24 feet, 0 inches.

Weight, 413 pounds.

Sectional area, 5.06 square inches.

Thickness of tubing, ".33 to ".40.

Initial deflection; horizontal, ".11; vertical, ".29.

Gauged length, 100 inches.

Counterweighted at middle.

Applied loads.		In gauged length.		Deflections at middle.		Remarks.
Total.	Per square inch.	Compression.	Set.	Horizontal.	Vertical.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
5,060	1,000	0.	0.	0.	0.	
25,300	5,000	.0144	.....	.01	.01	
50,600	10,000	.0312	.....	.04	.01	
.....	1,000	.....	.0005	.01	0.	
75,900	15,000	.0477	.....	.07	.05	
101,200	20,000	.0664	.....	.11	.11	
.....	1,000	.....	.0015	.04	.02	
106,260	21,000	.0670	.....	.14	.15	
111,320	22,000	.0698	.....	.16	.15	
116,380	23,000	.0714	.....	.19	.21	
121,440	24,000	.0790	.....	.24	.35	
						Ultimate strength.

Failed by triple flexure, deflecting in the directions of the initial bends.

No. 1875.

Lap-welded tubing, 5" nominal diameter.

Flat ends.

Length, 24 feet, 0 inches.

Weight, 424½ pounds.

Sectional area, 5.20 square inches.

Initial deflection; horizontal, ".10, vertical, ".09.

Gauged length, 100 inches.

Counterweighted at middle.

Applied loads.		In gauged length.		Deflections at middle.		Remarks.
Total.	Pounds per square inch.	Compression.	Set.	Horizontal.	Vertical.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inches.</i>	<i>Inches.</i>	Initial load.
5,200	1,000	0.	0.	0.	0.	
26,000	5,000	.0153	.....	0.	.02	
52,000	10,000	.0333	.....	0.	.03	
.....	1,000	.....	.0006	0.	.01	
78,000	15,000	.0509	.....	.02	.04	
104,000	20,000	.0689	.....	.03	.04	
.....	1,000	.....	.0013	0.	.02	
109,200	21,000	.0725	.....	.05	.04	
114,400	22,000	.0762	.....	.05	.05	
119,600	23,000	.0800	.....	.06	.03	
124,800	24,000	.0840	.....	.07	.01	
130,000	25,000	.0878	.....	.08	.02	
.....	1,000	.....	.0030	0.	.02	
135,200	26,000	.0926		.11	.03	Ultimate strength. Load and deflections when ends left full bearing against the platforms of the testing machine.
140,400	27,000	.0974	.....	.19	.04	
85,000	16,350	.....	.....	2.92	abt.1.50	

Failed by triple flexure. The tubing sustained its maximum load until the horizontal deflection reached 1".

TABULATION OF COMPRESSION TESTS OF LAP-WELDED STEEL TUBING.

FLAT ENDS.

Number of test.	Lengths.			Sectional area.	Ultimate strength.	
	Feet.	Inches.	$\frac{1}{r}$		Total.	Per square inch.
				<i>Sq. in.</i>	<i>Pounds.</i>	<i>Pounds.</i>
1895.....	1	8 $\frac{3}{4}$	12.5	5.15	345,050	67,000
1896.....	1	8 $\frac{3}{4}$	12.5	5.24	347,700	66,350
1897.....	1	8 $\frac{3}{4}$	12.5	5.24	346,800	66,180
1891.....	3	5	25.0	5.34	222,600	41,700
1892.....	3	5	25.0	5.25	213,200	40,610
1893.....	3	5	25.0	5.17	206,000	39,850
1898.....	3	5 $\frac{1}{2}$	25.0	5.10	234,600	46,000
1899.....	3	5 $\frac{1}{2}$	25.0	5.18	224,100	43,260
1900.....	3	5 $\frac{1}{2}$	25.0	5.36	222,000	41,420
1901.....	5	11 $\frac{1}{2}$	37.5	5.06	172,040	34,000
1902.....	5	11 $\frac{1}{2}$	37.5	5.23	167,360	32,000
1903.....	5	11 $\frac{1}{2}$	37.5	5.34	169,500	31,740
1888.....	6	10 $\frac{1}{2}$	50.0	5.24	151,000	28,820
1889.....	6	10 $\frac{1}{2}$	50.0	5.19	166,080	32,000
1890.....	6	10 $\frac{1}{2}$	50.0	5.21	166,720	32,000
1904.....	6	10 $\frac{1}{2}$	50.0	5.33	159,900	30,000
1905.....	6	10 $\frac{1}{2}$	50.0	5.06	161,920	32,000
1906.....	6	10 $\frac{1}{2}$	50.0	5.25	168,000	32,000
1907.....	8	6 $\frac{1}{2}$	62.5	5.20	185,300	35,630
1908.....	8	6 $\frac{1}{2}$	62.5	5.08	157,480	31,000
1909.....	8	6 $\frac{1}{2}$	62.5	5.26	157,800	30,000
1894.....	10	3 $\frac{1}{2}$	73.3	5.16	170,280	33,000
1885.....	10	3 $\frac{1}{2}$	75.0	5.23	172,590	33,000
1886.....	10	3 $\frac{1}{2}$	75.0	5.19	171,270	33,000
1887.....	10	3 $\frac{1}{2}$	75.0	5.20	161,200	31,000
1882.....	13	8 $\frac{1}{2}$	100.0	5.26	163,060	31,000
1883.....	13	8 $\frac{1}{2}$	100.0	5.21	145,880	28,000
1884.....	13	8 $\frac{1}{2}$	100.0	5.17	160,270	31,000
1879.....	17	1 $\frac{1}{2}$	125.0	5.21	151,090	29,000
1880.....	17	1 $\frac{1}{2}$	125.0	5.07	132,000	26,030
1881.....	17	1 $\frac{1}{2}$	125.0	5.21	151,090	29,000
1876.....	20	6 $\frac{1}{2}$	150.0	5.11	132,800	26,000
1877.....	20	6 $\frac{1}{2}$	150.0	5.17	139,590	27,000
1878.....	20	6 $\frac{1}{2}$	150.0	5.16	118,680	23,000
1873.....	24	0	175.0	5.04	126,000	25,000
1874.....	24	0	175.0	5.06	121,440	24,000
1875.....	24	0	175.0	5.20	140,400	27,000

LAP-WELDED STEEL TUBING.

TENSILE TESTS.

Dimensions.		Sectional area.	Elastic limit.		Tensile strength.		Elongation in 4 inches.		Area at fracture.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
Width.	Thick-ness.		Total.	Per square inch.	Total.	Per square inch.						
<i>Inch.</i>	<i>Inch.</i>	<i>Sq. inch.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Inches.</i>	<i>Per cent.</i>		<i>Per cent.</i>		
1.00	.36	.36	12,600	35,000	20,300	56,390	1.34	33.5	.68X.23=	56.6	.24, .27, .58*, .25	Fine silky.
1.00	.36	.36	13,900	38,610	21,900	60,830	1.31	32.8	.69X.25=	51.9	.22, .55*, .33, .21	Do.
1.00	.35	.35	12,300	35,140	20,200	57,710	1.33	33.3	.68X.24=	53.4	.51*, .37, .24, .21	Do.

ROLLED H SECTIONS, STEEL.

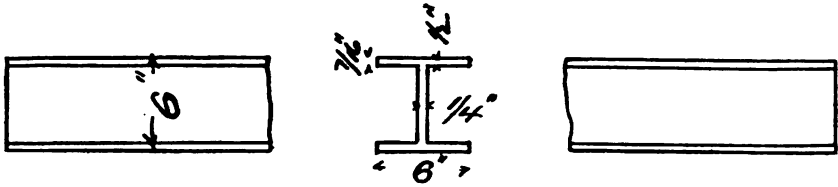
COMPRESSION TESTS.

DIMENSIONS OF ROLLED SECTIONS.

Width of flanges, nominally, 6''. Depth of section, nominally, 6''.

ROLLED H SECTIONS, STEEL.

FLAT END TESTS.

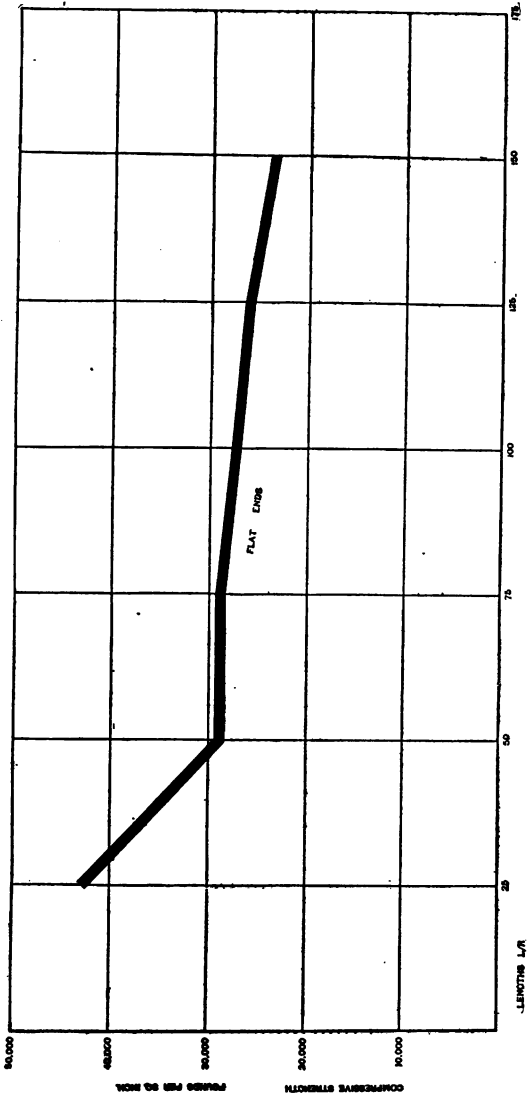


Nominal weight, 23.8 pounds per foot.
 Nominal sectional area, 7.00 square inches.
 Least radius of gyration, 1".54.

SCHEDULE OF LENGTHS.

3'-2½"	=	25 $\frac{L}{R}$
6'-5"	=	50 $\frac{L}{R}$
9'-7½"	=	75 $\frac{L}{R}$
12'-01"	=	100 $\frac{L}{R}$
16'-½"	=	125 $\frac{L}{R}$
19'-3"	=	150 $\frac{L}{R}$

ROLLED H SECTIONS.



Curve of compressive strength of rolled H sections, steel.

No. 1855.

Rolled H section.

Flat ends.

Length, 3 feet 2½ inches.

Weight, 80 pounds.

Sectional area, 7.33 square inches.

Gauged length, 20 inches.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
7,330	1,000	0.	0.	
36,650	5,000	.0024	.....	Elastic limit about 28,000.
73,300	10,000	.0056	0.	
109,950	15,000	.0089	.....	Rapid yielding.
146,600	20,000	.0122	0.	
183,250	25,000	.0161	.....	Ultimate strength.
219,900	30,000	.0225	.0037	
225,800	30,800	.....	.....	
316,000	43,110	.....	.....	

Flanges buckled.

No. 1856.

Rolled H section.

Flat ends.

Length, 3 feet 2½ inches.

Weight, 80 pounds.

Sectional area, 7.33 square inches.

Gauged length, 20 inches.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
7,330	1,000	0.	0.	
36,650	5,000	.0024	.....	Elastic limit.
73,300	10,000	.0057	0.	
109,950	15,000	.0091	.....	Scale generally disturbed. Length over all now 3'-2 7/10.
146,600	20,000	.0126	.0001	
183,250	25,000	.0165	.....	Ultimate strength.
190,580	26,000	.0174	.....	
197,910	27,000	.0183	.....	
205,240	28,000	.0202	.....	
212,570	29,000	.0233	.0044	
219,900	30,000	.....	.....	
298,400	40,710	.....	.....	

Flanges buckled.

No. 1857.

Rolled H section.

Flat ends.

Length, 3 feet 2½ inches.

Weight, 80 pounds.

Sectional area, 7.33 square inches.

Gauged length, 20 inches.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
7,330	1,000	0.	0.	Initial load.
36,650	5,000	.0020	.....	
73,300	10,000	.0051	0.	
109,950	15,000	.0084	.....	
146,600	20,000	.0119	— .0001	
183,250	25,000	.0159	.....	
190,580	26,000	.0167	.....	
197,910	27,000	.0176	.....	
206,240	28,000	.0185	.....	
212,570	29,000	.0202	.....	Elastic limit.
219,900	30,000	.0256	.0063	
327,900	44,730	.....	.....	Ultimate strength.

Length when maximum load was reached, 36'' .87.

Flanges buckled.

No. 1858.

Rolled H section.

Flat ends.

Length, 6 feet 5 inches.

Weight, 160½ pounds.

Sectional area, 7.35 square inches.

Gauged length, 50 inches.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
7,350	1,000	0.	0.	Initial load.
36,750	5,000	.0088	.....	
73,500	10,000	.0150	0.	
110,250	15,000	.0231	.....	
147,000	20,000	.0314	.0002	
183,750	25,000	.0400	.....	
191,100	26,000	.0421	.....	
198,450	27,000	.0444	.....	
206,800	28,000	.0486	.....	Elastic limit.
210,000	28,570	.0658	.....	
213,000	28,980	.....	.....	Ultimate strength.

Failed by triple flexure, deflecting perpendicular to web of specimen.

No. 1859.

Rolled H section.

Flat ends.

Length, 6 feet 5 inches.

Weight, 160 pounds.

Sectional area, 7.33 square inches.

Gauged length, 50 inches.

Applied loads.		In gauged length.		Deflections at middle.		Remarks.
Total.	Per square inch.	Compression.	Set.	Horizontal.	Vertical.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
7,330	1,000	0.	0.	0.	0.	
36,650	5,000	.0068	.....	0.	0.	
73,300	10,000	.0149	.....	0.	0.	
.....	1,000	.....	.0007	0.	0.	
109,950	15,000	.0238	.....	0.	0.	
146,600	20,000	.0327	.....	0.	0.	
.....	1,000	.....	.0023	0.	0.	
183,250	25,000	.0422	.....	0.	0.	
190,580	26,000	.0440	.....	0.	0.	
197,910	27,000	.0459		.01	.01	Elastic limit.
205,240	28,000	.0521		.03	.01	Ultimate strength.
209,800	28,620	.0588	.....	.06	.02	

Failed by triple flexure, deflecting perpendicular to web of specimen.

No. 1860.

Rolled H section.

Flat ends.

Length, 6 feet 5 inches.

Weight, 160 pounds.

Sectional area, 7.33 square inches.

Gauged length, 50 inches.

Applied loads.		In gauged length.		Deflections at middle.		Remarks.
Total.	Per square inch.	Compression.	Set.	Horizontal.	Vertical.	
<i>Pounds</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inches.</i>	<i>Inch.</i>	Initial load.
7,330	1,000	0.	0.	0.	0.	
36,650	5,000	.0064	.....	0.	0.	
73,300	10,000	.0150	.....	.01	0.	
.....	1,000	.....	0.	.01	0.	
109,950	15,000	.0229	.....	.01	0.	
146,600	20,000	.0314	.....	.01	0.	
.....	1,000	.....	.0003	.01	0.	
183,250	25,000	.0413	.....	.01	0.	
190,580	26,000	.0437	.....	.01	0.	
197,910	27,000	.0470		.01	0.	Ultimate strength.
205,240	28,000	.0510	.....	—	0.	
212,570	29,000	.0613	.....	— .06	.01	
194,000	26,470			—1.04	.02	Load and deflections when ends left full bearing against plat-forms of testing machine.

Failed by triple flexure, deflecting perpendicular to web of specimen.

No. 1861.

Rolled H section.

Flat ends.

Length, 9 feet 7½ inches.

Weight, 239 pounds.

Sectional area, 7.30 square inches.

Gauged length, 50 inches.

Counterweighted at middle.

Applied loads.		In gauged length.		Deflections at middle.		Remarks.
Total.	Per square inch.	Compression.	Set.	Horizontal.	Vertical.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inches.</i>	<i>Inch.</i>	
7,300	1,000	0.	0.	0.	0.	Initial load.
36,500	5,000	.0070	.....	0.	0.	
73,000	10,000	.0150	.....	.01	0.	
.....	1,000	.....	0.	.01	0.	
109,500	15,000	.0232	.....	.01	.01	
146,000	20,000	.0317	.....	.01	.01	
.....	1,000	.....	.0004	.01	0.	
182,500	25,000	.0402	.....	.01	.01	Snapping sounds. Scale starts locally.
.....	1,000	.....	.0007	0.	0.	
189,800	26,000	.0421	.....	.02	.01	
197,100	27,000	.0445	.....	.03	.01	
204,400	28,000	.0489	.....	.05	.01	Elastic limit.
211,700	29,000	.0665	.....	.17	— .02	Ultimate strength.
179,000	24,520	.....	.....	1.12	— .03	Load and deflections when ends left full bearing.

Failed by triple flexure, perpendicular to web of specimen, increasing the initial deflection of the specimen. The maximum deflection occurred about 10" from middle of length.

No. 1862.

Rolled H section.

Flat ends.

Length, 9 feet 7½ inches.

Weight, 239 pounds.

Sectional area, 7.30 square inches.

Initial deflection: horizontal, ".04; vertical, ".12.

Gauged length, 50 inches.

Counterweighted at middle.

Applied loads.		In gauged lengths.		Deflections at middle.		Remarks.
Total.	Per square inch.	Compression.	Set.	Horizontal.	Vertical.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inches.</i>	<i>Inch.</i>	
7,300	1,000	0.	0.	0.	0.	Initial load.
36,500	5,000	.0071	.....	.01	.01	
73,000	10,000	.0158	.....	.01	.01	
.....	1,000	.....	0.	.01	.01	
109,500	15,000	.0238	.....	.01	.01	
146,000	20,000	.0321		.02	.02	Elastic limit.
.....	1,000	.....	.0001	.01	.01	
182,500	25,000	.0406	.....	.02	.02	
.....	1,000	.....	.0004	.01	.01	
189,800	26,000	.0430	.....	.03	.03	
197,100	27,000	.0461		.04	.03	Ultimate strength.
204,400	28,000	.0517	.....	.09	.04	
211,700	29,000	.0580	.....	.14	.06	
172,000	.....	.....	.....	1.27	.34	
140,000	.....	.....	.....	2.64	.40	

Failed by triple flexure, perpendicular to web, of specimen. Maximum deflection, 8" eccentric.

No. 1863.

Rolled H section.

Flat ends.

Length, 9 feet 7½ inches.

Weight, 239 pounds.

Sectional area, 7.30 square inches.

Initial deflection: horizontal, ".04; vertical, ".07.

Gauged length, 50 inches.

Counterweighted at middle.

Applied loads.		In gauged length.		Deflections at middle.		Remarks.
Total.	Per square inch.	Compression.	Set.	Horizontal.	Vertical.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	
7,300	1,000	0.	0.	0.	0.	Initial load.
36,500	5,000	.0066	-----	0.	.01	
73,000	10,000	.0149	-----	.01	.01	
-----	1,000	-----	0.	0.	0.	
109,500	15,000	.0231	-----	.03	.01	
146,000	20,000	.0312	-----	.03	.02	
-----	1,000	-----	— .0004	.02	.01	
182,500	25,000	.0402	-----	.03	.02	
-----	1,000	-----	0.	.01	.01	
189,800	26,000	.0421	-----	.03	.02	
197,100	27,000	.0444	-----	.03	.02	Elastic limit.
204,400	28,000	.0502	-----	— .07	.03	Ultimate strength.
209,000	28,630	-----	-----	— .20	.06	
184,000	-----	-----	-----	.98	.10	Load and deflection when ends left full bearing against platforms of testing machine.

Snapping sounds heard and scale started off the specimen, locally, under 10,000 pounds per square inch and each higher load, increasing in frequency as the loads advanced.

No. 1864.

Rolled H section.

Flat ends.

Length, 12 feet 10 inches.

Weight, 318 pounds.

Sectional area, 7.29 square inches.

Initial deflection; wavy in both directions.

Gauged length, 100 inches.

Counterweighted at middle.

Applied loads.		In gauged length.		Deflections at middle.		Remarks.
Total.	Per square inch.	Compression.	Set.	Horizontal.	Vertical.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inches.</i>	<i>Inch.</i>	Initial load.
7,290	1,000	0.	0.	0.	0.	
36,450	5,000	.0137	.....	.01	0.	
72,900	10,000	.0307	.....	.02	.01	
.....	1,000	.....	0.	.01	.01	
109,350	15,000	.0478	.....	.01	.02	
145,800	20,000	.0646	.....	.01	.02	
.....	1,000	.....	.0007	.01	.01	
182,250	25,000	.0873	.....	0.	.02	
.....	1,000	.....	.0070	.01	.01	
189,540	26,000	.0941	.....	— .02	.02	
196,830	27,000	.1004	.....	— .04	.02	
204,120	28,000	.1170	.....	— .24	.02	
168,000	.....	.....	.....	— 1.27	— .04	

Ultimate strength.

Load and deflections when ends left full bearing against platforms of the testing machine.

Failed by triple flexure, deflecting perpendicular to the web of the specimen.

No. 1865.

Rolled H section.

Flat ends.

Length, 12 feet 10 inches.

Weight, 317 pounds.

Sectional area, 7.27 square inches.

Initial deflection; horizontal, 0."; vertical, ".15.

Gauged length, 100 inches.

Counterweighted at the middle.

Applied loads.		In gauged length.		Deflections at middle.		Remarks.
Total.	Per square inch.	Compression.	Set.	Horizontal.	Vertical.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inch.</i>	Initial load.
7,270	1,000	0.	0.	0.	0.	
36,350	5,000	.0140	-----	0.	0.	
72,700	10,000	.0310	-----	.01	0.	
-----	1,000	-----	0.	0.	0.	
109,050	15,000	.0484	-----	.01	0.	
145,400	20,000	.0671	-----	.03	.01	
-----	1,000	-----	.0020	0.	0.	
181,750	25,000	.0957	-----	.11	.05	
-----	1,000	-----	.0036	.10	.05	
189,020	26,000	.1097	-----	.26	.11	Ultimate strength.
176,400	-----	-----	-----	.88	.25	Load and deflections when ends left full bearings against plat-forms of testing machine.

Failed by triple flexure, deflecting perpendicular to web of specimen.

No. 1866.

Rolled H section.

Flat ends.

Length, 12 feet 10 inches.

Weight, 317 pounds.

Sectional area, 7.27 square inches.

Initial deflection, 0."

Gauged length, 100 inches.

Counterweighted at middle.

Applied loads.		In gauged length.		Deflections at middle.		Remarks.
Total.	Per square inch.	Compression.	Set.	Horizontal.	Vertical.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inches.</i>	<i>Inch.</i>	
		0.	0.	0.	0.	Initial load.
7,270	1,000	0.	0.	0.	0.	
36,350	5,000	.0150	.....	0.	0.	
72,700	10,000	.0321	.....	0.	0.	
.....	1,000	.....	.0010	0.	0.	
109,050	15,000	.0490	.....	.01	0.	
145,400	20,000	.0662	.....	.02	0.	
.....	1,000	.....	.0015	0.	0.	
181,750	25,000	.0870	.....	.03	.01	
.....	1,000	.....	.0064	.01	0.	
189,020	26,000	.0934		.04	.01	Ultimate strength.
196,290	27,000	.1001	.....	.07	.01	
203,560	28,000	.1190	.....	.27	— .02	
174,000	.....	.....	.....	1.12	.04	
130,000				2.99		Load and deflection as the deformation of the specimen was further increased.

Failed by triple flexure, deflecting perpendicular to the web of the specimen.

No. 1867.

Rolled H section.

Flat ends.

Length, 16 feet $\frac{1}{2}$ inch.

Weight, 398 pounds.

Sectional area, 7.30 square inches.

Initial deflection; horizontal, ".08; vertical, ".23.

Gauged length, 100 inches.

Counterweighted at middle.

Applied loads.		In gauged length.		Deflections at middle.		Remarks.
Total.	Per square inch.	Compression.	Set.	Horizontal.	Vertical.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inches.</i>	<i>Inch.</i>	
7,300	1,000	0.	0.	0.	0.	Initial load.
36,500	5,000	.0143	-----	0.	0.	
73,000	10,000	.0309	-----	0.	.02	
-----	1,000	-----	.0005	0.	0.	
109,500	15,000	.0473	-----	.02	.02	
146,000	20,000	.0667	-----	0.	.03	
-----	1,000	-----	.0018	0.	0.	
182,500	25,000	.0841	-----	.01	.08	
-----	1,000	-----	.0067	.01	.02	
189,800	26,000	.0885	-----	.02	.10	
197,100	27,000	.0945	-----	.10	.21	Ultimate strength.
172,000	-----	-----	-----	.79	.37	Load and deflections when ends left full bearing against platforms of the testing machine.
116,000	-----	-----	-----	1.85	.55	Load sustained when deflections reached the amounts here stated.
80,000	-----	-----	-----	abt.5.00	-----	Load sustained when deflection reached amount here stated.

Failed by triple flexure, deflecting chiefly in a horizontal direction, perpendicular to the web of the specimen, and in the direction of the initial deflection.

No. 1868.

Rolled H section.

Flat ends.

Length, 16 feet 0½ inch.

Weight, 396½ pounds.

Sectional area, 7.27 square inches.

Initial deflection; horizontal, ".10; vertical, ".02.

Gauged length, 100 inches.

Counterweighted at middle.

Applied loads.		In gauged length.		Deflections at middle.		Remarks.
Total.	Per square inch.	Compression.	Set.	Horizontal.	Vertical.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inches.</i>	<i>Inch.</i>	Initial load.
7,270	1,000	0.	0.	0.	0.	
36,350	5,000	.0141	-----	0.	0.	
72,700	10,000	.0317	-----	0.	.01	
-----	1,000	-----	.0002	0.	0.	
109,050	15,000	.0483	-----	0.	.01	
145,400	20,000	.0656	-----	.02	.01	
-----	1,000	-----	.0009	0.	.01	
181,750	25,000	.0847	-----	.09	.02	
-----	1,000	-----	.0032	.06	.01	
199,020	26,000	.0894	-----	.18	.03	Ultimate strength.
168,000	-----	-----	-----	1.12	.04	Load and deflections when ends left full bearing against the platforms of the testing machine.

Failed by triple flexure, deflecting perpendicular to the web of the specimen, and in the direction of the initial bend.

No. 1869.

Rolled H section.

Flat ends.

Length, 16 feet 0½ inch.

Weight, 395½ pounds.

Sectional area, 7.25 square inches.

Initial deflection; horizontal, ".17; vertical, ".08.

Gauged length, 100 inches.

Counterweighted at middle.

Applied loads.		In gauged length.		Deflections at middle.		Remarks.
Total.	Per square inch.	Compression.	Set.	Horizontal.	Vertical.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inches.</i>	<i>Inch.</i>	
7,250	1,000	0.	0.	0.	0.	Initial load.
36,250	5,000	.0145	-----	0.	0.	
72,500	10,000	.0310	-----	.01	0.	
-----	1,000	-----	.0003	0.	0.	
108,750	15,000	.0480	-----	.03	.01	
145,000	20,000	.0653	-----	.05	.02	Ultimate strength.
-----	1,000	-----	.0015	0.	0.	
181,250	25,000	.0897	-----	.40	.03	
-----	1,000	-----	.0025	.27	.02	
168,000	-----	-----	-----	1.26	.06-	

Failed by triple flexure, deflecting perpendicular to the web of the specimen, and following the direction of the initial bend.

No. 1870.

Rolled H section.

Flat ends.

Length, 19 feet 3 inches.

Weight, 476½ pounds.

Sectional area, 7.28 square inches.

Initial deflection; horizontal ".03; vertical, ".05.

Gauged length, 100 inches.

Counterweighted at middle.

Applied loads.		In gauged length.		Deflections at middle.		Remarks.
Total.	Per square inch.	Compression.	Set.	Horizontal.	Vertical.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inches.</i>	<i>Inch.</i>	
7,280	1,000	0.	0.	0.	0.	Initial load.
36,400	5,000	.0141	.....	0.	.02	
72,800	10,000	.0314	.....	.01	.02	
.....	1,000	.....	.0006	0.	0.	
109,200	15,000	.0489	.....	0.	.03	
145,600	20,000	.0668	.....	— .01	.03	
.....	1,000	.....	.0019	0.	.01	
179,600	24,670	.....	.....	— .63	.04	Ultimate strength.
145,000	.....	.....	.....	1.98	.06	Load and deflections when ends left full bearing against the plat-forms of the testing machine.

Failed by triple flecture, deflecting perpendicular to the web of the specimen, failing in a direction opposite that of the initial bend.

No. 1871.

Rolled H section.

Flat ends.

Length, 19 feet 3 inches.

Weight, 477 pounds.

Sectional area, 7.29 square inches.

Initial deflection; horizontal, 0."; vertical, ".13.

Gauged length, 100 inches.

Counterweighted at middle.

Applied loads.		In gauged length.		Deflections at middle.		Remarks.
Total.	Per square inch.	Compression.	Set.	Horizontal.	Vertical.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inches.</i>	<i>Inch.</i>	
7,290	1,000	0.	0.	0.	0.	Initial load.
36,450	5,000	.0145	.....	.01	.02	
72,900	10,000	.0317	.....	.02	.03	
.....	1,000	.....	.0009	0.	.01	
109,350	15,000	.0486	.....	.05	.04	
145,900	20,000	.0662		.06	.05	Ultimate strength.
.....	1,000	.....	.0023	.01	.02	
153,090	21,000	.0700	.....	.09	.05	
160,380	22,000	.0735	.....	.11	.05	
167,670	23,000	.0781	.....	.16	.05	
.....				.65		
143,000				1.49	.05	Load and deflections when ends left full bearing against the platforms of the testing machine. Horizontal deflection increased from ".16 to ".65 while the specimen was still kept under the maximum load.

Failed by triple flexure, deflecting perpendicular to the web of the specimen.

No. 1872.

Rolled H section.

Flat ends.

Length, 19 feet 3 inches.

Weight, 480 pounds.

Sectional area, 7.33 square inches.

Initial deflection; horizontal, ".17; vertical, ".13.

Counterweighted at middle.

Gauged length, 100 inches.

Applied loads.		In gauged length.		Deflections at middle.		Remarks.
Total.	Per square inch.	Compression.	Set.	Horizontal.	Vertical.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	<i>Inches.</i>	<i>Inch.</i>	
7,330	1,000	0.	0.	0.	0.	Initial load.
36,650	5,000	.0141	-----	.04	0.	
73,300	10,000	.0315	-----	.07	0.	
-----	1,000	-----	.0009	.02	0.	
109,950	15,000	.0476	-----	.10	.02	
146,600	20,000	.0641	-----	.16	.03	Ultimate strength.
-----	1,000	-----	.0015	.05	.01	
133,930	21,000	.0679	-----	.21	.04	
161,280	22,000	.0715	-----	.27	.05	
168,590	23,000	.0772	-----	.58	.08	
146,000	-----	-----	-----	1.60	.12	Load and deflections when ends left full bearing against the platforms of the testing machine.
53,000	-----	-----	-----	-----	-----	Load sustained when horizontal deflection reached 6".5.

Failed by triple flexure, deflecting perpendicular to the web of the specimen.

**TABULATION OF COMPRESSION TESTS OF ROLLED H SECTIONS,
STEEL.**

FLAT ENDS.

Number of test.	Lengths.			Sectional area.	Ultimate strength.	
	Feet.	Inches.	$\frac{1}{r}$		Total.	Per square inch.
				<i>Sq. in.</i>	<i>Pounds.</i>	<i>Pounds.</i>
1855.....	3	2½	25	7.33	316,000	43,110
1856.....	3	2½	25	7.33	298,400	40,710
1857.....	3	2½	25	7.33	327,900	44,730
1858.....	6	5	50	7.35	213,000	28,980
1859.....	6	5	50	7.33	209,800	28,620
1860.....	6	5	50	7.33	212,570	29,000
1861.....	9	7½	75	7.30	211,700	29,000
1862.....	9	7½	75	7.30	211,700	29,000
1863.....	9	7½	75	7.30	209,000	28,630
1864.....	12	10	100	7.29	204,120	28,000
1865.....	12	10	100	7.27	189,020	26,000
1866.....	12	10	100	7.27	203,560	28,000
1867.....	16	½	125	7.30	197,100	27,000
1868.....	16	½	125	7.27	189,020	26,000
1869.....	16	½	125	7.25	181,250	25,000
1870.....	19	3	150	7.28	179,600	24,670
1871.....	19	3	150	7.29	167,670	23,000
1872.....	19	3	150	7.33	168,590	23,000

ROLLED H SECTIONS.

TENSILE TESTS.

Description.	Dimensions.		Sectional area.	Elastic limit.		Tensile strength.		Elongation in 4 inches.		Area at fracture.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Width.	Thick-ness.		Total.	Per square inch.	Total.	Per square inch.	Inches.	Per cent.				
Flange.....	Inches. 2.50 2.50 2.50 2.50	Inch. .46 .50 .49 .49	Sq. inches. 1.20 1.25 1.25 1.25	Pounds. 34,200 36,800 36,400 37,500	Pounds. 28,600 31,640 30,580 30,480	Pounds. 98,000 12,100 69,200 69,800	Pounds. 37,170 57,680 56,280 56,780	Inches. 1.60 1.67 1.69 1.61	Per cent. 40.0 41.8 38.8 40.3	1.82X.33 = .608 1.80X.32 = .576 1.80X.32 = .569 1.86X.34 = .643	Per cent. 48.5 53.9 52.1 47.7	.20, .22, .43, .75* .24, .28, .83*, .27 .20, .26, .83*, .31 .21, .75*, .37, .24	Fine silky. Do. Do. Do.
Web.....	2.00 2.00	.27 .27	.54 .54	17,600 17,200	32,690 31,880	29,800 29,500	55,190 54,630	1.43 1.55	35.8 38.8	1.51X.18 = .272 1.49X.18 = .268	49.6 50.3	.20, .26, .67*, .30 .20, .26, .40, .67*	Do. Do.

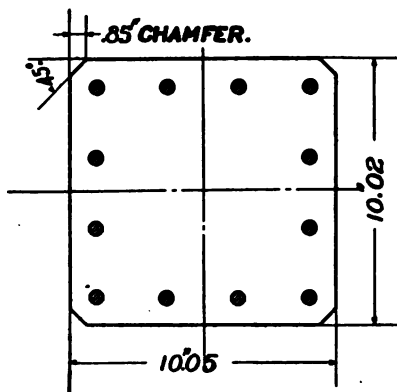
CONCRETE AND MORTAR COLUMNS.

PLAIN AND REËNFORCED WITH LONGITUDINAL
STEEL BARS OR WIRE HELIX.

No. 1834.

1:2½:5 Mixture.

Reinforced with 12 steel bars, each ½" diameter. Rods extended from lower end longitudinally through the column and projected above the upper end. A perforated end plate was used at the upper end of the column, the perforations being clearance holes for the reinforcing bars. The lower end of the column rested on a ½" steel plate. The bars were encircled by 11 collars of ½" round wire, spaced 9" apart.



Composition by volume: Red Ring Portland cement, 1; river sand, 2½; gravel (¾"), 5.

Age, set in air, 7 months.

Weight of column, total, 795.5 pounds.

Weight of concrete, 723 pounds = 134.5 pounds per cubic foot.

Weight of steel bars and collars, 72.5 pounds.

Height of column, 96.15 inches.

Sectional area of column, gross $(10.05 \times 10.02) - (4 \times \frac{1}{2} \times .85 \times .85) = 99.26$ square inches.

Sectional area of steel bars, total, 2.36 square inches.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	Pounds.	Inch.	Inch.	
9,926	100	0.	0.	Initial load. Loaded with 6,000 pounds before testing.
14,889	150	.0012	.0003	
19,852	200	.0018	.0003	
24,815	250	.0027	.0001	
29,778	300	.0038	.0001	
34,741	350	.0047	.0002	
39,704	400	.0058	.0004	
44,667	450	.0068	.0005	
49,630	500	.0078	.0006	
54,593	550	.0090	.0008	
59,556	600	.0100	.0009	
.....	600	.0100	.0009	
64,519	650	.0110	.....	
69,482	700	.0120	.....	
				E (100-600)=2,747,000 pounds per square inch.

No. 1834—Continued.

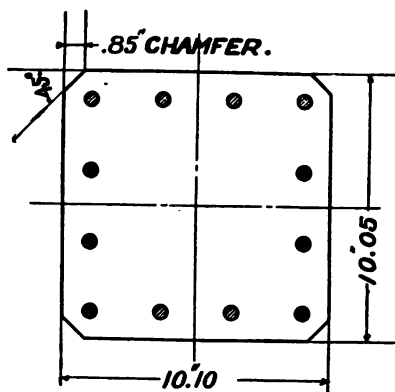
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
74,445	750	.0131	.....	
79,408	800	.0145	.....	
84,371	850	.0164	.....	
89,334	900	.0175	.....	
94,297	950	.0185	.....	
99,260	1,000	.0199	.0020	E (600-1,000)=2,273,000 pounds per square inch.
.....	600	.0120	.0020	
.....	600	.0121	.0020	
109,186	1,100	.0228	.....	
119,112	1,200	.0250	.....	
129,038	1,300	.0279	.....	
138,964	1,400	.0307	.....	
148,890	1,500	.0344	.0039	
.....	600	.0162	.0038	
.....	600	.0151	.0027	Set after resting $\frac{1}{2}$ hour.
.....	600	.0151	.0027	
158,816	1,600	.0380	.....	
168,742	1,700	.0416	.....	
178,668	1,800	.0469	.....	
188,594	1,900	.0499	.....	
198,520	2,000	.0543	.0048	E (1,000-2,000)=1,582,000 pounds per square inch.
.....	600	.0223	.0047	
.....	600	.0221	.0044	
208,446	2,100	.0667	.....	Surface cracks appear.
215,000	2,166	.....	.....	Ultimate strength.

Column failed at a distance of from 1 to 3 feet from lower end.

No. 1835.

1:2½:5 Mixture.

Reinforcement same as in column of test No. 1834.



Composition by volume: Red Ring Portland cement, 1; river sand, 2½; gravel (¾"), 5.

Age, set in air, 7 months.

Weight of column, total, 782 pounds.

Weight of concrete, 709.5 pounds = 131.1 pounds per cubic foot.

Weight of steel bars and collars, 72.5 pounds.

Height of column, 96.00 inches.

Sectional area of column, gross, $(10.10 \times 10.05) - (4 \times \frac{1}{2} \times .85 \times .85) = 100.06$ square inches.

Sectional area of steel bars, total, 2.36 square inches.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	Pounds.	Inch.	Inch.	
10,000	100	0.	0.	Initial load. Loaded with 6,000 pounds before testing.
15,009	150	.0013	.0003	
20,012	200	.0029	.0005	
25,015	250	.0043	.0006	
30,018	300	.0056	.0008	
35,021	350	.0069	.0008	
40,024	400	.0084	.0010	
45,027	450	.0099	.0011	
50,030	500	.0111	.0012	
55,033	550	.0126	.0014	
60,036	600	.0141	.0015	
-----	600	.0143	.0014	E (100-600) = 1,938,000 pounds per square inch.
65,039	650	.0159	-----	
70,042	700	.0172	-----	
75,045	750	.0185	-----	
80,048	800	.0200	-----	
85,051	850	.0216	-----	
90,054	900	.0230	-----	
95,057	950	.0245	-----	
100,060	1,000	.0260	.0021	E (600-1,000) = 1,818,000 pounds per square inch.
-----	600	.0168	.0022	
-----	600	.0169	.0023	

No. 1835—Continued.

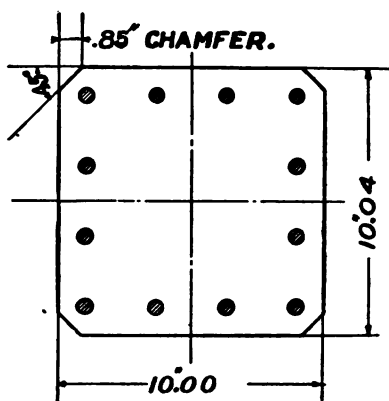
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
110,066	1,100	.0293		Snapping sounds.
120,072	1,200	.0321	.....	
130,078	1,300	.0352	.....	
140,084	1,400	.0398	.....	
150,090	1,500	.0429	.0031	
.....	600	.0210	.0030	
.....	600	.0210	.0030	
160,096	1,600	.0471	.....	
170,102	1,700	.0517	.....	
180,108	1,800	.0568	.....	
190,114	1,900	.0625	.0055	
.....	600	.0276	.0055	Ultimate strength.
.....	600	.0276	.0055	
191,400	1,913	.....	.....	

Column failed at a distance of from 1 to 2 feet from lower end, opening longitudinal and oblique cracks.

No. 1836.

1:2½:5 Mixture.

Reinforcement same as in column of test No. 1834.



Composition by volume: Red Ring Portland cement, 1; river sand, 2½; gravel (¾"), 5.

Age, set in air, 7 months.

Weight of column, total, 778 pounds.

Weight of concrete, 705.5 pounds = 132.2 pounds per cubic foot.

Weight of steel bars and collars, 72.5 pounds.

Height of column, 96.15 inches.

Sectional area of column, gross, $(10.00 \times 10.04) - (4 \times \frac{1}{2} \times .85 \times .85) = 98.60$ square inches.

Sectional area of steel bars, total, 2.36 square inches.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	Pounds.	Inch.	Inch.	
9,860	100	0.	0.	Initial load. Loaded with 5,000 pounds before testing.
14,790	150	.0017	.0003	
19,720	200	.0034	.0005	
24,650	250	.0048	.0007	
29,580	300	.0062	.0008	
34,510	350	.0075	.0008	
39,440	400	.0089	.0008	
44,370	450	.0100	.0009	
49,300	500	.0114	.0009	
54,230	550	.0124	.0009	
59,160	600	.0137	.0010	E (100-600) = 1,969,000 pounds per square inch.
	600	.0139	.0010	
64,090	650	.0149	.....	
69,020	700	.0161	.....	
73,950	750	.0174	.....	
78,880	800	.0189	.....	
83,810	850	.0202	.....	
88,740	900	.0216	.....	
93,670	950	.0229	.....	
98,600	1,000	.0243	.0014	E (600-1,000) = 1,961,000 pounds per square inch.
.....	600	.0155	.0013	
.....	600	.0156	.0011	

No. 1836—Continued.

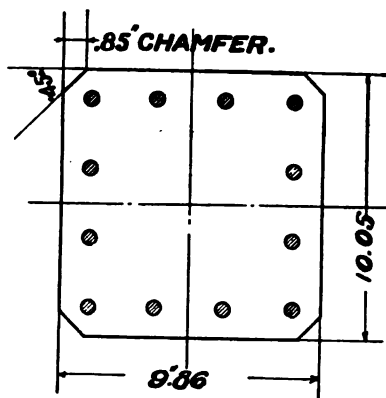
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
108,460	1,100	.0272	-----	
118,320	1,200	.0303	-----	
128,180	1,300	.0331	-----	
138,040	1,400	.0366	-----	
147,900	1,500	.0402	.0024	Cracks at lower end of column.
-----	600	.0198	.0023	
-----	600	.0198	.0022	
157,760	1,600	.0457	-----	
167,620	1,700	.0490	-----	
177,480	1,800	.0533	-----	
187,340	1,900	.0601	-----	
197,200	2,000	.0659	.0069	E (1,000-2,000)=1,385,000 pounds per square inch.
-----	600	.0290	.0069	
-----	600	.0289	.0069	
207,060	2,100	.0910	-----	
212,600	2,156	-----	-----	Ultimate strength.

Opened oblique and longitudinal cracks near middle of length of column.

No. 1837.

1: 2½: 5 Mixture.

Reinforcement same as in column of test No. 1834.



Composition by volume: Red Ring Portland cement, 1; river sand, 2½; gravel (¾"), 5.

Age, set in air, 7 months.

Weight of column, total, 785 pounds.

Weight of concrete, 712.5 pounds = 134.9 pounds per cubic foot.

Weight of steel bars and collars, 72.5 pounds.

Height of column, 96.09 inches.

Sectional area of column, gross $(9.86 \times 10.05) - (4 \times \frac{1}{2} \times .85 \times .85) = 97.65$ square inches.

Sectional area of steel bars, total, 2.36 square inches.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	Pounds.	Inch.	Inch.	
9,554	98	0.	0.	Initial load. Loaded with 6,000 pounds before testing.
14,331	147	.0011	.0002	
19,108	196	.0022	.0003	
23,885	245	.0034	.0004	
28,662	294	.0046	.0005	
33,439	342	.0059	.0006	
38,216	391	.0071	.0007	
42,993	440	.0083	.0009	
47,770	489	.0094	.0010	
52,547	538	.0106	.0011	
57,324	587	.0118	.0013	E (98-587) = 2,329,000 pounds per square inch.
.....	587	.0118	.0014	
62,101	636	.0130	.....	
66,878	685	.0140	.....	
71,655	734	.0152	.....	
76,432	783	.0165	.....	
81,209	832	.0178	.....	
85,986	881	.0190	.....	
90,763	929	.0202	.....	
95,540	978	.0215	.0020	E (587-978) = 2,172,000 pounds per square inch.
.....	587	.0140	.0021	
.....	587	.0140	.0021	

No. 1837—Continued.

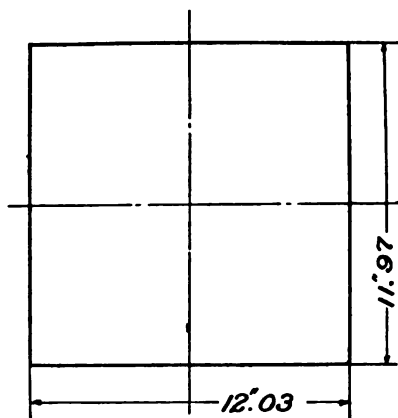
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
105,094	1,076	.0243	.....	
114,648	1,174	.0267	.....	
124,202	1,272	.0293	.....	
133,756	1,370	.0324	.....	
143,310	1,468	.0348	.0037	
.....	587	.0176	.0036	
.....	587	.0176	.0035	
152,864	1,565	.0395	.....	
162,418	1,663	.0425	.....	
171,972	1,761	.0468	.....	
181,526	1,859	.0500	.....	
191,080	1,957	.0537	.0047	E (978-1,957)=1,659,000 pounds per square inch.
.....	587	.0213	.0047	
.....	587	.0219	.0045	
200,634	2,055	.0606	.....	
210,188	2,152	.0684	.....	
223,000	2,284	.....	.....	Ultimate strength.

Column failed by opening oblique and longitudinal cracks about 1 foot above the middle of its height.

No. 1838.

1:2:4 Mixture.

Plain column, without reënforcing metal.



Composition, by volume: Saylor's Portland cement, 1; sand (10-mesh sieve), 2; trap rock ($\frac{1}{8}$ " to $\frac{1}{4}$ "), 4.

Age, set in air, 7 months.

Weight of column, total, 1,158 pounds.

Weight of concrete, 1,158 pounds = 144.7 pounds per cubic foot.

Height of column, 96.06 inches.

Sectional area, $11''.97 \times 12''.03 = 144$ square inches.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i> 14,400	<i>Pounds.</i> 100	<i>Inch.</i> 0.	<i>Inch.</i> 0.	Initial load. Loaded with 7,000 pounds before testing.
21,600	150	.0005	0.	
28,800	200	.0010	.0001	
36,000	250	.0019	.0002	
43,200	300	.0028	.0003	
50,400	350	.0037	.0005	
57,600	400	.0045	.0006	
64,800	450	.0058	.0008	
72,000	500	.0065	.0009	
79,200	550	.0077	.0011	
86,400	600	.0088	.0014	
	600	.0089	.0015	
93,600	650	.0098	.....	
100,800	700	.0110	.....	
108,000	750	.0123	.....	
115,200	800	.0139		E (100-600) = 3,378,000 pounds per square inch.
122,400	850	.0150	.....	
129,600	900	.0164	.....	
136,800	950	.0179	.....	
144,000	1,000	.0195	.0038	
	600	.0118	.0038	E (600-1,000) = 2,410,000 pounds per square inch.
	600	.0118	.0038	

No. 1838—Continued.

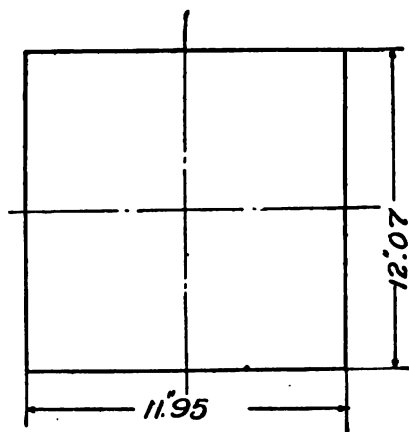
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
158,400	1,100	.0228	.....	
172,800	1,200	.0259	.....	
187,200	1,300	.0294	.....	
201,600	1,400	.0330	.....	
216,000	1,500	.0384	.0107	
.....	600	.0207	.0105	
.....	600	.0208	.0105	
230,400	1,600	.0442	.....	
244,800	1,700	.0507	.....	
274,600	1,907	.....	.....	Ultimate strength.

Opened oblique and longitudinal cracks near lower end of column.

No. 1839.

1:1½:3 Mixture.

Plain column, without reinforcing metal.



Composition, by volume: Saylor's Portland cement, 1; sand (10-mesh sieve), 1½; trap rock (⅓" to ½"), 3.

Age, set in air, 7 months.

Weight of column, total, 1,157 pounds.

Weight of concrete, 1,157 pounds = 144.2 pounds per cubic foot.

Height of column, 96.12 inches.

Sectional area, 11".95 × 12".07 = 144.24 square inches.

Gauged length, 50".

Bearing plate at one end of column was crowning.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	Pounds.	Inch.	Inch.	
14,424	100	0.	0.	Initial load. Loaded with 6,000 pounds before testing.
21,636	150	.0000	0.	
28,848	200	.0002	0.	
36,060	250	.0005	0.	
43,272	300	.0011	0.	
50,484	350	.0020	-.0001	
57,696	400	.0028	-.0001	
64,908	450	.0037	0.	
72,120	500	.0047	0.	
79,332	550	.0054	0.	
86,544	600	.0065	.0001	E (100-600) = 3,906,000 pounds per square inch.
.....	600	.0065	.0001	
93,756	650	.0075	.....	
100,968	700	.0085	.....	
108,180	750	.0096	.....	
115,392	800	.0106	.....	
122,604	850	.0118	.....	
129,816	900	.0129	.....	
137,028	950	.0140	.....	
144,240	1,000	.0153	.0014	E (600-1,000) = 2,667,000 pounds per square inch.
.....	600	.0084	.0014	
.....	600	.0084	.0014	

No. 1839—Continued.

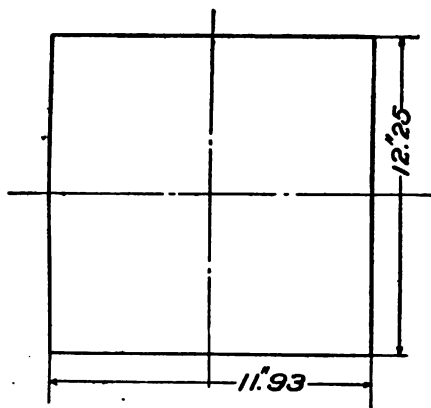
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
158,664	1,100	.0180	.....	
173,088	1,200	.0206	.....	
187,512	1,300	.0233	.....	
201,936	1,400	.0264	.....	
216,360	1,500	.0295	.0050	
.....	600	.0130	.0050	
.....	600	.0130	.0049	
230,784	1,600	.0339	.....	
245,208	1,700	.0367	.....	
259,632	1,800	.0405	.....	
274,056	1,900	.0450	.....	
288,480	2,000	.0509	.0127	E (1,000-2,000)=2,058,000 pounds per square inch.
.....	600	.0230	.0126	
.....	600	.0229	.0124	
335,000	2,323	.....	.....	Ultimate strength.

Oblique lines of fracture, about 3 feet long, in upper half of column.

No. 1840.

1:1:2 Mixture.

Plain column, without reënforcing metal.



Composition, by volume: Saylor's Portland cement, 1; sand (10-mesh sieve), 1; trap rock ($\frac{1}{8}$ " to $\frac{1}{4}$ "), 2.

Age, set in air, 7 months.

Weight of column, total, 1,171 pounds.

Weight of concrete, 1,171 pounds = 144.1 pounds per cubic foot.

Height of column, 96.12 inches.

Sectional area, $11''.93 \times 12''.25 = 146.14$ square inches.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	Pounds.	Inch.	Inch.	
14,614	100	0.	0.	Initial load.
21,921	150	.0003	0.	
29,228	200	.0005	.0001	
36,535	250	.0010	.0001	
43,842	300	.0017	.0002	
51,149	350	.0022	.0002	
58,456	400	.0029	.0003	
65,763	450	.0036	.0004	
73,070	500	.0041	.0005	
80,377	550	.0049	.0005	
87,684	600	.0056	.0007	E (100-600) = 5,102,000 pounds per square inch.
	600	.0057	.0007	
94,991	650	.0067	.....	
102,298	700	.0074	.....	
109,605	750	.0081	.....	
116,912	800	.0088	.....	
124,219	850	.0096	.....	
131,526	900	.0103	.....	
138,833	950	.0110	.....	
146,140	1,000	.0118	.0013	E (600-1,000) = 3,571,000 pounds per square inch.
	600	.0066	.0013	
	600	.0066	.0013	
160,754	1,100	.0135	.....	
175,368	1,200	.0151	.....	
189,982	1,300	.0169	.....	
204,596	1,400	.0188	.....	
219,210	1,500	.0218	.0030	

No. 1840—Continued.

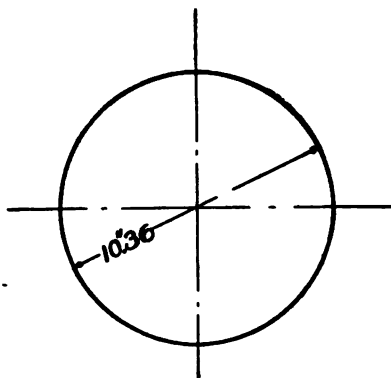
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
.....	600	.0086	.0030	
.....	600	.0085	.0029	
233,824	1,600	.0232	.....	
248,438	1,700	.0248	.....	
263,052	1,800	.0267	.....	
277,666	1,900	.0284	.....	
292,280	2,000	.0306	.0048	E (1,000-2,000)=3,268,000 pounds per square inch.
.....	600	.0107	.0047	
.....	600	.0106	.0046	
306,894	2,100	.0331	.....	
321,508	2,200	.0350	.....	
336,122	2,300	.0371	.....	
350,736	2,400	.0397	.....	
365,360	2,500	.0424	.0074	
.....	600	.0137	.0071	
.....	600	.0136	.0070	
498,000	3,408	.....	.....	Ultimate strength.

Column failed near upper end, opening oblique and longitudinal cracks from 1 to 2 feet from the top.

No. 1841.

Neat cement column.

Plain column, without reënforcing metal.



Composition: Neat Saylor's Portland cement.

Age, set in air, 7 months.

Weight of column, total, 612 pounds = 130.5 pounds per cubic foot

Height of column, 96.16 inches.

Diameter of column, 10.36 inches.

Sectional area, 84.30 square inches.

Gauged length, 50".

Cylindrical surface checked with fine hair lines at intervals of 3" to 14" each.

Cracks were both circular and longitudinal.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
8,430	100	0.	0.	Initial load. Loaded with 7,000 pounds before testing.
12,645	150	.0010	.0002	
16,860	200	.0023	.0003	
21,075	250	.0035	.0005	
25,290	300	.0046	.0005	
29,505	350	.0058	.0005	
33,720	400	.0072	.0007	
37,935	450	.0084	.0007	
42,150	500	.0096	.0008	
46,365	550	.0108	.0010	
50,580	600	.0121	.0009	E (100-600) = 2,232,000 pounds per square inch.
	600	.0122	.0010	
54,795	650	.0134	.....	
59,010	700	.0146	.....	
63,225	750	.0159	.....	
67,440	800	.0171	.....	
71,655	850	.0185	.....	
75,870	900	.0197	.....	
80,085	950	.0208	.....	
84,300	1,000	.0222	.0016	E (600-1,000) = 2,128,000 pounds per square inch.
	600	.0127	.0016	
	600	.0127	.0015	Column remained under initial load 20 hours.
92,730	1,100	.0248	.....	
101,160	1,200	.0273	.....	
109,590	1,300	.0294	.....	
118,020	1,400	.0318	.....	
126,450	1,500	.0339	.0028	

No. 1841—Continued.

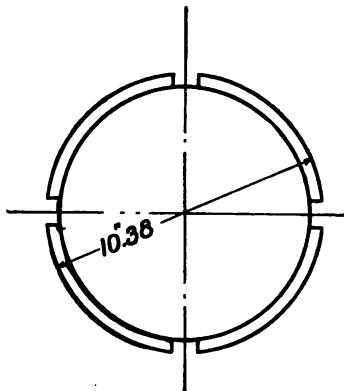
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
.....	600	.0143	.0026	
.....	600	.0139	.0026	
134,880	1,600	.0361	.....	
143,810	1,700	.0386	.....	
151,740	1,800	.0410	.....	
160,170	1,900	.0433	.....	
168,600	2,000	.0459	.0037	E (1,000-2,000) = 2,315,000 pounds per square inch.
.....	600	.0154	.0036	
.....	600	.0150	.0034	
177,030	2,100	.0474	.....	
185,460	2,200	.0500	.....	
193,890	2,300	.0522	.....	
202,320	2,400	.0544	.....	
210,750	2,500	.0567	.0048	
.....	600	.0165	.0045	
.....	600	.0164	.0045	
445,000	5,279	.....	.....	Ultimate strength.

Upper 5 feet of length of column burst into numerous fragments when maximum load was reached.

No. 1842.

1: 2: 3½ Mixture.

Reinforced by means of steel wire helix, 1" pitch, ".30 diameter of wire; interior diameter of helix, approximately, 8".78. Wooden strips were used in mold for centering the helix. The space occupied by these strips is represented by four longitudinal grooves, 1" $\times$ ½" each. Pitch of helix regulated and maintained by means of four strips of steel, ½" $\times$ ".037 thick.



Composition, by volume: Saylor's Portland cement, 1; sand (10-mesh sieve), 2; trap rock (½" to 1½"), 3½.

Age, set in air, 7 months 17 days.

Weight of column, total, 718 pounds.

Weight of concrete, 658 pounds = 147.4 pounds per cubic foot.

Weight of helix, complete, 60 pounds.

Height of column, 95.90 inches.

Diameter of column, 10.38 inches.

Sectional area of column, gross, 82.62 square inches.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	Pounds.	Inch.	Inch.	
8,262	100	0.	0.	Initial load. Loaded with 6,000 pounds before testing.
12,393	150	.0004	.0001	
16,524	200	.0008	.0002	
20,655	250	.0013	.0002	
24,786	300	.0018	.0003	
28,917	350	.0026	.0003	
33,048	400	.0033	.0005	
37,179	450	.0041	.0005	
41,310	500	.0049	.0007	
45,441	550	.0059	.0008	
49,572	600	.0070	.0009	E (100-600) = 4,098,000 pounds per square inch.
.....	600	.0070	.0010	
53,703	650	.0077	.....	
57,834	700	.0088	.....	
61,965	750	.0097	.....	
66,096	800	.0106	.....	
70,227	850	.0118	.....	
74,358	900	.0128	.....	
78,489	950	.0141	.....	
82,620	1,000	.0152	.0025	
				E (600-1,000) = 3,030,000 pounds per square inch.

No. 1842—Continued.

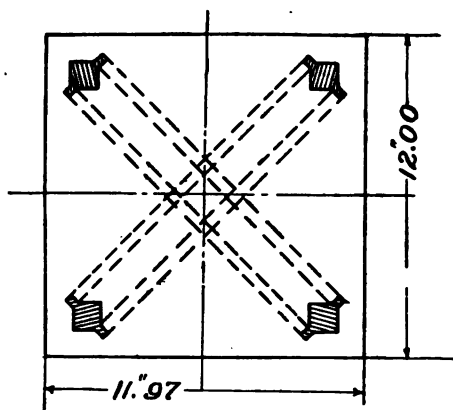
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
-----	600	.0089	.0025	Rested 2 hours.
-----	600	.0086	.0023	
90,882	1,100	.0175	-----	
99,144	1,200	.0201	-----	
107,406	1,300	.0226	-----	
115,668	1,400	.0254	-----	
123,930	1,500	.0281	.0058	
-----	600	.0129	.0057	
-----	600	.0130	.0058	
132,192	1,600	.0321	-----	E (1,000-2,000)=2,392,000 pounds per square inch.
140,454	1,700	.0349	-----	
148,716	1,800	.0382	-----	
156,978	1,900	.0422	.0132	
165,240	2,000	.0468	-----	
-----	600	.0219	.0130	
-----	600	.0218	.0130	
173,502	2,100	.0536	-----	
181,764	2,200	.0602	-----	
190,026	2,300	.0642	-----	
198,288	2,400	.0690	-----	E (2,000-3,000)=1,701,000 pounds per square inch.
206,550	2,500	.0762	.0285	
-----	600	.0384	.0283	
-----	600	.0383	.0282	
214,812	2,600	.0862	-----	
223,074	2,700	.0909	-----	
231,336	2,800	.0992	-----	
239,598	2,900	.1049	-----	
247,860	3,000	.1127	.0497	
-----	600	.0610	.0492	
-----	600	.0604	.0488	Ultimate strength.
256,122	3,100	.1271	-----	
264,384	3,200	.1373	-----	
272,646	3,300	.1469	-----	
280,908	3,400	.1575	-----	
289,170	3,500	.1678	.0835	
-----	600	.0970	.0829	
-----	600	.0964	.0827	
390,000	4,720	-----	-----	

Failed by triple flexure.

No. 1843.

1: 2: 4 Mixture.

Reinforced with 4 Kahn bars, each $\frac{1}{2}$ " square by 94".60 long, with prongs about $\frac{1}{4}$ " wide by $\frac{1}{4}$ " thick, bent toward center of column at right angles to axis. The ends of Kahn bars were embraced by collars or bands of $\frac{1}{4}$ " square steel wire. Longitudinal bars were flush with the lower end of the column and were covered at their upper ends with about $1\frac{1}{2}$ " thickness of concrete and neat cement facing.



Composition, by volume: Saylor's Portland cement, 1; sand (10-mesh sieve), 2; trap rock ($\frac{1}{8}$ " to $\frac{1}{2}$ "), 4.

Age, set in air, 7 months 22 days.

Weight of column, total, 1,237 pounds.

Weight of concrete, 1,142 pounds = 146.5 pounds per cubic foot.

Weight of Kahn bars and collars, 95 pounds.

Height of column, 96.10 inches.

Sectional area of column, gross, $11".97 \times 12".00 = 143.64$ square inches.

Sectional area of Kahn bars, total, $4 \times .75 \times .75 = 2.25$ square inches.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	Pounds.	Inch.	Inch.	
14,364	100	0.	0.	Initial load. Loaded with 8,000 pounds before testing.
21,546	150	.0007	0.	
28,728	200	.0015	0.	
35,910	250	.0026	.0002	
43,092	300	.0038	.0003	
50,274	350	.0049	.0005	
57,456	400	.0059	.0007	
64,638	450	.0071	.0008	
71,820	500	.0081	.0009	
79,002	550	.0093	.0010	
86,184	600	.0102	.0010	E (100-600) = 2,717,000 pounds per square inch.

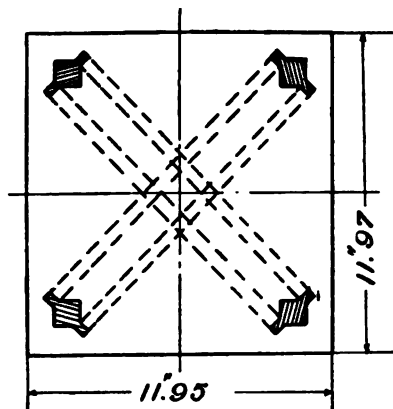
No. 1843—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
.....	600	.0103	.0011	E (600-1,000)—2,353,000 pounds per square inch.
93,366	650	.0114	.....	
100,548	700	.0125	.....	
107,730	750	.0135	.....	
114,912	800	.0148	.....	
122,094	850	.0159	.....	
129,276	900	.0173	.....	
136,458	950	.0186	.....	
143,640	1,000	.0198	.0021	
.....	600	.0127	.0021	
.....	600	.0126	.0022	
158,004	1,100	.0224	.....	
172,368	1,200	.0250	.....	
186,732	1,300	.0275	.....	
201,096	1,400	.0300	.....	
215,460	1,500	.0332	.0047	
.....	600	.0168	.0046	E (1,000-2,000)—2,058,000 pounds per square inch.
.....	600	.0168	.0045	
229,824	1,600	.0368	.....	
244,188	1,700	.0398	.....	
258,552	1,800	.0433	.....	
272,916	1,900	.0469	.....	
287,280	2,000	.0518	.0098	
.....	600	.0245	.0098	
.....	600	.0244	.0097	
301,644	2,100	.0533	.....	
316,008	2,200	.0672	.....	
330,372	2,300	.0734	.....	
344,736	2,400	.0843	.....	
359,100	2,500	.1043	.0494	
.....	600	.0631	.0490	Ultimate strength.
.....	600	.0629	.0488	
369,000	2,569	.....	.....	

Column failed near upper end. Oblique and longitudinal cracks opened and steel bars buckled.

No. 1844.

1 : 2 : 4 Mixture.

Reinforced with four, $\frac{3}{4}$ " Kahn bars, as described for column of test No. 1843.Composition, by volume: Saylor's Portland cement, 1; sand (10-mesh sieve), 2; trap rock ($\frac{1}{8}$ " to $\frac{1}{2}$ "), 4.

Age, set in air, 7 months 24 days.

Weight of column, total, 1,230 pounds.

Weight of concrete, 1,135 pounds = 146.4 pounds per cubic foot.

Weight of reinforcement, complete, 95 pounds.

Height of column, 96.02 inches.

Sectional area of column, gross, $11''.95 \times 11''.97 = 143.04$ square inches.Sectional area of Kahn bars, total, $4 \times .75 \times .75 = 2.25$ square inches.

Gauged length, 50".

Bearing plates were crowning at each end of column.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
14,304	100	0.	0.	Initial load. Loaded with 8,000 pounds before testing.
21,456	150	.0013	.0002	
28,608	200	.0025	.0004	
35,760	250	.0039	.0006	
42,912	300	.0050	.0008	
50,064	350	.0061	.0010	
57,216	400	.0074	.0012	
64,368	450	.0084	.0013	
71,520	500	.0098	.0014	
78,672	550	.0107	.0018	
85,824	600	.0120	.0019	E (100-600) = 2,475,000 pounds per square inch.
	600	.0120	.0020	
92,976	650	.0131	.....	
100,128	700	.0144	.....	
107,280	750	.0155	.....	
114,432	800	.0166	.....	
121,584	850	.0179	.....	
128,736	900	.0191	.....	
135,888	950	.0204	.....	
143,040	1,000	.0218	.0033	
				E (600-1,000) = 2,381,000 pounds per square inch.

No. 1844—Continued.

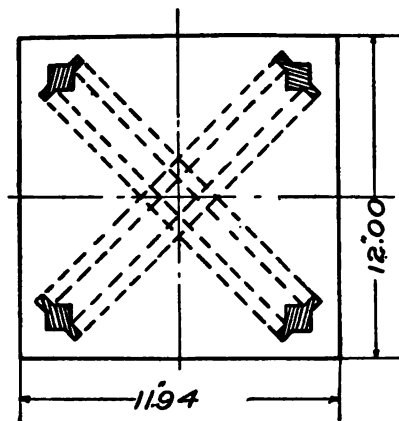
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
.....	600	.0146	.0035	
.....	600	.0145	.0035	
157,344	1,100	.0242	.....	
171,648	1,200	.0269	.....	
185,952	1,300	.0285	.....	
200,256	1,400	.0325	.....	
214,560	1,500	.0359	.0070	
.....	600	.0194	.0070	
.....	600	.0195	.0070	
228,864	1,600	.0394	.....	
243,168	1,700	.0442	.....	
257,472	1,800	.0504	.....	
271,776	1,900	.0575	.....	
286,080	2,000	.0700	.0296	E (1,000-2,000) = 2,283,000 pounds per square inch.
.....	600	.0421	.0294	
.....	600	.0420	.0293	
299,500	2,094	.....	.....	Ultimate strength.

Failed near lower end of column, opening oblique and longitudinal cracks.

No. 1845.

1 : 1½ : 3 Mixture.

Reinforced with four, ¾" Kahn bars, as described for column of test No. 1843.



Composition, by volume: Saylor's Portland cement, 1; sand (10-mesh sieve), 1½; trap rock (½" to 1½"), 3.

Age, set in air, 7 months 25 days.

Weight of column, total, 1,223 pounds.

Weight of concrete, 1,129 pounds = 145.2 pounds per cubic foot.

Weight of reinforcement, complete, 94 pounds.

Height of column, 96.08 inches.

Sectional area of column, gross, 11" .94 × 12" .00 = 143.28 square inches.

Sectional area of Kahn bars, total, 4 × .75 × .75 = 2.25 square inches.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
14,328	100	0.	0.	Initial load. Loaded with 9,000 pounds before testing.
21,492	150	.0011	.0003	
28,656	200	.0020	.0004	
35,820	250	.0031	.0005	
42,984	300	.0042	.0007	
50,148	350	.0051	.0008	
57,312	400	.0063	.0009	
64,476	450	.0074	.0010	
71,640	500	.0084	.0012	
78,804	550	.0094	.0013	
85,968	600	.0105	.0015	E (100-600) = 2,778,000 pounds per square inch.
.....	600	.0106	.0015	
93,132	650	.0118	.....	
100,296	700	.0128	.....	
107,460	750	.0138	.....	
114,624	800	.0150	.....	
121,788	850	.0160	.....	
128,952	900	.0172	.....	
136,116	950	.0185	.....	
143,280	1,000	.0197	.0026	E (600-1,000) = 2,469,000 pounds per square inch.

No. 1845—Continued.

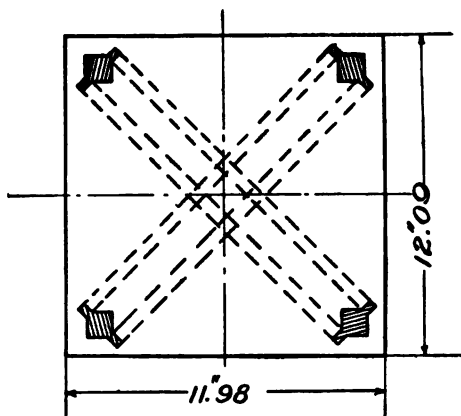
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
.....	600	.0126	.0026	
.....	600	.0125	.0026	
157,608	1,100	.0224	.....	
171,936	1,200	.0245	.....	
186,264	1,300	.0270	.....	
200,592	1,400	.0295	.....	
214,920	1,500	.0321	.0044	
.....	600	.0159	.0044	
.....	600	.0159	.0044	
229,248	1,600	.0360	.....	
243,576	1,700	.0397	.....	
257,904	1,800	.0429	.....	
272,232	1,900	.0479	.....	
286,560	2,000	.0538	.0144	E (1,000-2,000)=2,242,000 pounds per square inch.
.....	600	.0270	.0140	
.....	600	.0269	.0140	
300,888	2,100	.0648	.....	
315,216	2,200	.0724	.....	
329,544	2,300	.0845	.....	
343,872	2,400	.1250	.0699	
.....	600	.0832	.0695	
.....	600	.0830	.0695	
346,000	2,415	.....	.....	Ultimate strength.

Column failed along the middle of its length, opening oblique and longitudinal cracks.

No. 1846.

1: 1½: 3 Mixture.

Reinforced with four ¾" Kahn bars, as described for column of test No. 1843.



Composition, by volume: Saylor's Portland cement, 1; sand (10-mesh sieve), 1½; trap rock (⅓" to ½"), 3.

Age, set in air, 8 months 20 days.

Weight of column, total, 1,233 pounds.

Weight of concrete, 1,137 pounds = 144.7 pounds per cubic foot.

Weight of reinforcement, complete, 96 pounds.

Height of column, 96.07 inches.

Sectional area of column, gross, $11''.98 \times 12''.09 = 144.84$ square inches.Sectional area of Kahn bars, total, $4 \times .75 \times .75 = 2.25$ square inches.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	Pounds.	Inch.	Inch.	
14,484	100	0.	0.	Initial load. Loaded with 9,000 pounds before testing.
21,726	150	.0009	.0002	
28,968	200	.0017	.0002	
36,210	250	.0026	.0003	
43,452	300	.0037	.0004	
50,694	350	.0047	.0005	
57,936	400	.0057	.0007	
65,178	450	.0067	.0008	
72,420	500	.0078	.0008	
79,662	550	.0087	.0009	
86,904	600	.0098	.0010	E (100-600) = 2,841,000 pounds per square inch.
.....	600	.0099	.0010	
94,146	650	.0109	.....	
101,388	700	.0119	.....	
108,630	750	.0130	.....	
115,872	800	.0140	.....	
123,114	850	.0152	.....	
130,356	900	.0164	.....	
137,598	950	.0176	.....	
144,840	1,000	.0188	.0020	E (600-1,000) = 2,500,000 pounds per square inch.

No. 1846—Continued.

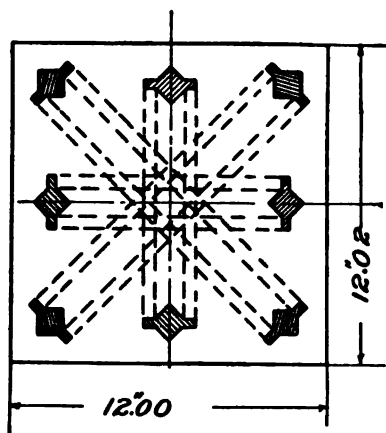
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
-----	600	.0117	.0020	
-----	600	.0116	.0019	
159,324	1,100	.0217	-----	
173,808	1,200	.0239	-----	
188,292	1,300	.0262	-----	
202,776	1,400	.0287	-----	
217,260	1,500	.0315	.0038	
-----	600	.0149	.0036	
-----	600	.0147	.0036	
231,744	1,600	.0345	-----	
246,228	1,700	.0375	-----	
260,712	1,800	.0408	-----	
275,196	1,900	.0450	-----	
289,680	2,000	.0506	.0103	E (1,000-2,000)=2,137,000 pounds per square inch.
-----	600	.0240	.0103	
-----	600	.0238	.0102	
304,164	2,100	.0583	-----	
318,648	2,200	.0675	-----	
333,132	2,300	.0920	.0437	Ultimate strength.
-----	600	.0570	.0436	
-----	600	.0566	.0434	

Opened oblique and longitudinal cracks 9" to 24" from lower end of column.

No. 1847.

1 : 2 : 4 Mixture.

Reinforced with 8 Kahn bars, each $\frac{1}{2}$ " square, with prongs bent toward center of column at right angles to axis. The ends of Kahn bars were embraced by collars of $\frac{1}{4}$ " square steel wire.



Composition by volume: Saylor's Portland cement, 1; sand (10-mesh sieve), 2; trap rock ($\frac{1}{8}$ " to $\frac{1}{2}$ "), 4.

Age, set in air, 8 months 21 days.

Weight of column, total, 1,206 pounds.

Weight of concrete, 1,114 pounds = 141.9 pounds per cubic foot.

Weight of reinforcement, complete, 92 pounds.

Height of column, 96.30 inches.

Sectional area of column, gross, $12'' .00 \times 12'' .02 = 144.24$ square inches.

Sectional area of Kahn bars, total, $8 \times .50 \times .50 = 2.00$ square inches.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
14,424	100	0.	0.	Initial load. Loaded with 10,000 pounds before testing.
21,636	150	.0014	.0003	
28,848	200	.0032	.0006	
36,060	250	.0050	.0010	
43,272	300	.0067	.0012	
50,484	350	.0084	.0016	
57,696	400	.0102	.0017	
64,908	450	.0121	.0019	
72,120	500	.0139	.0021	
79,332	550	.0158	.0024	
86,544	600	.0177	.0026	E (100-600) = 1,656,000 pounds per square inch.
.....	600	.0180	.0028	
93,756	650	.0197	.....	
100,968	700	.0216	.....	
108,180	750	.0235	.....	
115,392	800	.0254	.....	
122,604	850	.0275	.....	
129,816	900	.0296	.....	
137,028	950	.0315	.....	
144,240	1,000	.0334	.0044	E (600-1,000) = 1,439,000 pounds per square inch.

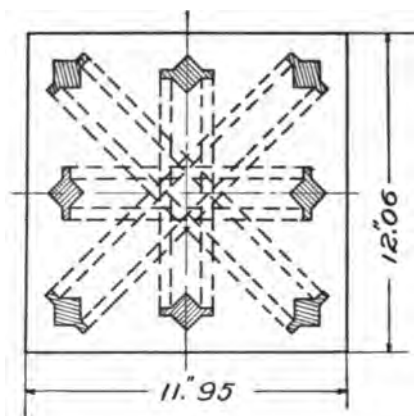
No. 1847—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
-----	600	.0233	.0044	
	600	.0233	.0042	
158,664	1,100	.0387	-----	
173,088	1,200	.0436	-----	
187,512	1,300	.0493	-----	
201,936	1,400	.0553	-----	
216,360	1,500	.0647	.0138	
-----	600	.0377	.0137	
	600	.0376	.0136	
230,784	1,600	.0798	-----	
245,208	1,700	.0995	-----	
259,632	1,800	.1420	.0806	Ultimate strength.
-----	600	.1026	.0795	
	600	.1023	.0797	

Oblique fracture near middle of length of column.

No. 1848.

1:2:4 Mixture.

Reinforced with eight $\frac{1}{2}$ " Kahn bars as described for column of test No. 1847.

Composition by volume: Saylor's Portland cement, 1; sand (10-mesh sieve), 2; trap rock ($\frac{1}{8}$ " to $\frac{1}{2}$ "), 4.

Age, set in air, 8 months 24 days.

Weight of column, total, 1,211 pounds.

Weight of concrete, 1,117 pounds = 142.8 pounds per cubic foot.

Weight of reinforcement, complete, 94 pounds.

Height of column, 96.12 inches.

Sectional area of column, gross, $11''.95 \times 12''.06 = 144.12$ square inches.

Sectional area of Kahn bars, total, $8 \times .50 \times .50 = 2.00$ square inches.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	Pounds.	Inch.	Inch.	
14,412	100	0.	0.	Initial load. Loaded with 11,000 pounds before testing.
21,618	150	.0020	.0004	
28,824	200	.0038	.0008	
36,030	250	.0058	.0010	
43,236	300	.0077	.0012	
50,442	350	.0094	.0014	
57,648	400	.0112	.0018	
64,854	450	.0129	.0020	
72,060	500	.0147	.0022	
79,266	550	.0165	.0025	
86,472	600	.0184	.0028	E (100-600) = 1,603,000 pounds per square inch.
	600	.0187	.0029	
93,678	650	.0204	.....	
100,884	700	.0221	.....	
108,090	750	.0238	.....	
115,296	800	.0257	.....	
122,502	850	.0273	.....	
129,708	900	.0293	.....	
136,914	950	.0313	.....	
144,120	1,000	.0330	.0047	E (600-1,000) = 1,575,000 pounds per square inch.

No. 1848—Continued.

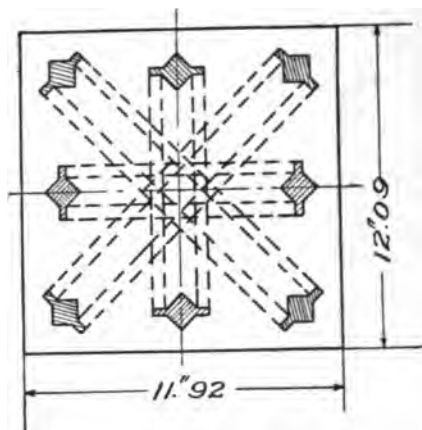
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
.....	600	.0236	.0048	
.....	600	.0235	.0048	
158,532	1,100	.0375	.....	
172,944	1,200	.0422	.....	
187,356	1,300	.0473	.....	
201,768	1,400	.0534	.....	
216,180	1,500	.0604	.0124	
.....	600	.0353	.0124	
.....	600	.0353	.0124	
.....	100	.....	.0110	Set after resting under initial load 16 hours.
230,562	1,600	.0762	.....	
245,004	1,700	.0884	.....	
259,416	1,800	.1120	.0538	
.....	600	.0764	.0538	
.....	600	.0761	.0538	
273,300	1,896	.....	.....	Ultimate strength.

Opened oblique and longitudinal cracks, 15'' to 30'' from lower end of column.

No. 1849.

1 :1½ :3 Mixture.

Reinforced with eight $\frac{1}{2}$ " Kahn bars, as described for column of test No. 1847.



Composition, by volume: Saylor's Portland cement, 1; sand (10-mesh sieve), $1\frac{1}{2}$; trap rock ($\frac{1}{8}$ " to $\frac{1}{4}$ "), 3.

Age, set in air, 8 months 25 days.

Weight of column, total, 1,236 pounds.

Weight of concrete, 1,144 pounds = 146.5 pounds per cubic foot.

Weight of reinforcement, complete, 92 pounds.

Height of column, 95.87 inches.

Sectional area of column, gross, $11''.92 \times 12''.09 = 144.11$ square inches.

Sectional area of Kahn bars, total, $8 \times .50 \times .50 = 2.00$ square inches.

Gauged length, 50''.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i> 14, 411	<i>Pounds.</i> 100	<i>Inch.</i> 0.	<i>Inch.</i> 0.	Initial load. Loaded with 11,000 pounds before testing.
21, 617	150	.0013	.0002	
28, 822	200	.0025	.0004	
36, 028	250	.0040	.0006	
43, 233	300	.0055	.0008	
50, 439	350	.0071	.0010	
57, 644	400	.0082	.0012	
64, 850	450	.0096	.0015	
72, 055	500	.0109	.0017	
79, 261	550	.0122	.0018	
86, 466	600	.0135	.0019	
-----	600	.0137	.0020	
93, 672	650	.0149	-----	
100, 877	700	.0162	-----	
108, 083	750	.0176	-----	
115, 288	800	.0188	-----	
122, 494	850	.0200	-----	
129, 699	900	.0216	-----	
136, 905	950	.0227	-----	
144, 110	1, 000	.0242	.0034	
				E(600-1,000)=2,174,000 pounds per square inch.

No. 1849—Continued.

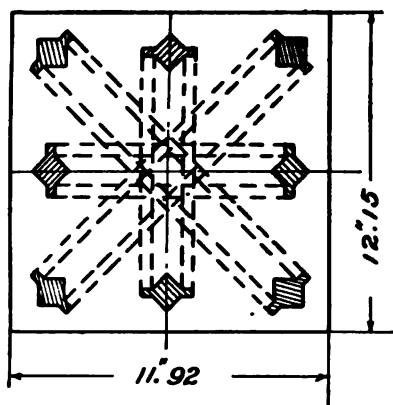
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
.....	600	.0165	.0034	
.....	600	.0165	.0034	
158,521	1,100	.0269	.....	
172,932	1,200	.0293	.....	
187,343	1,300	.0321	.....	
201,754	1,400	.0354	.....	
216,165	1,500	.0379	.0054	
.....	600	.0206	.0054	
.....	600	.0205	.0054	
230,576	1,600	.0421	.....	
244,987	1,700	.0458	.....	
259,398	1,800	.0488	.....	
273,809	1,900	.0528	.....	
288,220	2,000	.0569	.0111	E(1,000-2,000)=2,000,000 pounds per square inch.
.....	600	.0285	.0111	
.....	600	.0284	.0111	
302,631	2,100	.0658	.....	
317,042	2,200	.0730	.....	
331,453	2,300	.0823	.....	
345,864	2,400	.0928	.....	
360,275	2,500	.1092	.0505	
.....	600	.0667	.0505	
.....	600	.0664	.0505	
370,000	2,567	.....	.....	Ultimate strength.

Opened an oblique fracture along middle of height of column.
Reinforcing bars buckled outward as the fracture was developed.

No. 1850.

1:1½:3 Mixture.

Reinforced with eight ½" Kahn bars, as described for column of test No. 1847.



Composition, by volume: Saylor's Portland cement, 1; sand (10-mesh sieve), 1½"; trap rock (½" to ¾"), 3.

Age, set in air, 8 months 26 days.

Weight of column, total, 1,252 pounds.

Weight of concrete, 1,158 pounds = 147.4 pounds per cubic foot.

Weight of reinforcement, complete, 94 pounds.

Height of column, 96.05 inches.

Sectional area of column, gross, $11''.92 \times 12''.15 = 144.83$ square inches.Sectional area of Kahn bars, total, $8 \times .50 \times .50 = 2.00$ square inches.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	Pounds.	Inch.	Inch.	
14,483	100	0.	0.	Initial load. Loaded with 12,000 pounds before testing.
21,725	150	.0008	.0001	
28,966	200	.0017	.0003	
36,208	250	.0025	.0004	
43,449	300	.0037	.0005	
50,691	350	.0047	.0007	
57,932	400	.0058	.0008	
65,174	450	.0068	.0008	
72,415	500	.0078	.0009	
79,657	550	.0088	.0011	
86,898	600	.0098	.0013	E (100-600) = 2,941,000 pounds per square inch.
-----	600	.0099	.0013	
94,140	650	.0110	.....	
101,381	700	.0120	.....	
108,623	750	.0130	.....	
115,864	800	.0140	.....	
123,106	850	.0152	.....	
130,347	900	.0163	.....	
137,589	950	.0175	.....	
144,830	1,000	.0186	.0022	E (600-1,000) = 2,532,000 pounds per square inch.

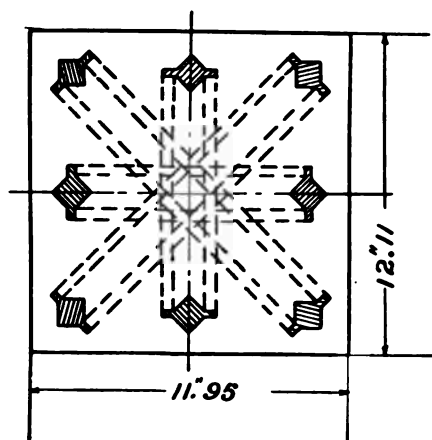
No. 1850—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
-----	600	.0120	.0022	E(1,000-2,000) = 2,381,000 pounds per square inch.
-----	600	.0120	.0022	
159,313	1,100	.0210	-----	
173,796	1,200	.0232	-----	
188,279	1,300	.0256	-----	
202,762	1,400	.0280	-----	
217,245	1,500	.0305	.0041	
-----	600	.0150	.0039	
-----	600	.0150	.0040	
231,728	1,600	.0335	-----	
246,211	1,700	.0359	-----	
260,694	1,800	.0381	-----	
275,177	1,900	.0411	-----	
289,660	2,000	.0445	.0071	
-----	600	.0198	.0070	
-----	600	.0190	.0063	
304,143	2,100	.0496	-----	
318,626	2,200	.0532	-----	
333,109	2,300	.0568	-----	
347,592	2,400	.0617	-----	
362,075	2,500	.0689	.0197	
-----	600	.0334	.0196	Ultimate strength.
-----	600	.0333	.0196	
376,558	2,600	.0840	-----	
390,000	2,693	-----	-----	

Opened oblique and longitudinal cracks in lower 2 feet of length of column.

No. 1851.

1:1:2 Mixture.

Reinforced with eight $\frac{1}{2}$ " Kahn bars, as described for column of test No. 1847.Composition, by volume: Saylor's Portland cement, 1; sand (10-mesh sieve), 1; trap rock ($\frac{1}{8}$ " to $\frac{1}{2}$ "), 2.

Age, set in air, 9 months 2 days.

Weight of column, total, 1,270 pounds.

Weight of concrete, 1,175 pounds = 149.7 pounds per cubic foot.

Weight of reinforcement, complete, 95 pounds.

Height of column, 96.06 inches.

Sectional area of column, gross, $11''.95 \times 12''.11 = 144.71$ square inches.Sectional area of Kahn bars, total, $8 \times .50 \times .50 = 2.00$ square inches.

Gauged length, 50''.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i> 14,471	<i>Pounds.</i> 100	<i>Inch.</i> 0.	<i>Inch.</i> 0.	Initial load. Loaded with 12,000 pounds before testing.
21,707	150	.0005	0.	
28,942	200	.0010	0.	
36,178	250	.0018	.0002	
43,413	300	.0027	.0004	
50,649	350	.0034	.0005	
57,884	400	.0042	.0005	
65,120	450	.0050	.0005	
72,355	500	.0060	.0006	
79,591	550	.0069	.0007	
86,826	600	.0078	.0008	E (100-600) = 3,571,000 pounds per square inch.
.....	600	.0078	.0009	
94,062	650	.0087	.....	
101,297	700	.0095	.....	
108,533	750	.0104	.....	
115,768	800	.0113	.....	
123,004	850	.0123	.....	
130,239	900	.0131	.....	
137,475	950	.0141	.....	
144,710	1,000	.0151	.0017	
				E (600-1,000) = 3,125,000 pounds per square inch.

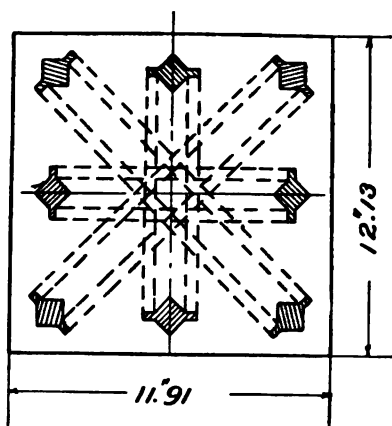
No. 1851—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
.....	600	.0091	.0017	
.....	600	.0091	.0017	
156, 181	1, 100	.0173	.....	
173, 652	1, 200	.0194	.....	
188, 123	1, 300	.0211	.....	
202, 594	1, 400	.0232	.....	
217, 065	1, 500	.0251	.0028	
.....	600	.0110	.0028	
.....	600	.0110	.0028	
231, 536	1, 600	.0277	.....	
246, 007	1, 700	.0296	.....	
260, 478	1, 800	.0316	.....	
274, 949	1, 900	.0336	.....	
289, 420	2, 000	.0359	.0044	E (1,000-2,000)=2,762,000 pounds per square inch.
.....	600	.0136	.0044	
.....	600	.0134	.0043	
303, 891	2, 100	.0387	.....	
318, 362	2, 200	.0413	.....	
332, 833	2, 300	.0438	.....	
347, 804	2, 400	.0469	.....	
361, 775	2, 500	.0502	.0083	
.....	600	.0191	.0082	
.....	600	.0188	.0087	
376, 246	2, 600	.0551	.....	
390, 717	2, 700	.0590	.....	
405, 188	2, 800	.0625	.....	
419, 659	2, 900	.0677	.....	
434, 130	3, 000	.0721	.0194	E (2,000-3,000)=2,358,000 pounds per square inch.
.....	600	.0304	.0191	
.....	600	.0300	.0190	
491, 000	3, 393	.....	.....	Ultimate strength.

Opened an oblique line of fracture across column at middle of its height.

No. 1852.

1 : 1 : 2 Mixture.

Reinforced with eight $\frac{1}{4}$ " Kahn bars, as described for column of test No. 1847.

Composition by volume: Saylor's Portland cement, 1; sand (10-mesh sieve), 1; trap rock ($\frac{1}{8}$ " to $\frac{1}{2}$ "), 2.

Age, set in air, 9 months 6 days.

Weight of column, total, 1,235 pounds.

Weight of concrete, 1,142 pounds = 145.5 pounds per cubic foot.

Weight of reinforcement, complete, 93 pounds.

Height of column, 96.17 inches.

Sectional area of column, gross, $11''.91 \times 12''.13 = 144.47$ square inches.

Sectional area of Kahn bars, total, $8 \times .50 \times .50 = 2.00$ square inches.

Gauged length, 50".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	Pounds.	Inch.	Inch.	
14,447	100	0.	0.	Initial load. Loaded with 8,000 pounds before testing.
21,671	150	.0004	0.	
28,894	200	.0010	.0002	
36,118	250	.0019	.0003	
43,341	300	.0027	.0003	
50,565	350	.0038	.0004	
57,788	400	.0047	.0005	
65,012	450	.0057	.0006	
72,235	500	.0068	.0008	
79,459	550	.0079	.0008	
86,682	600	.0089	.0009	E (100-600)=3,125,000 pounds per square inch.
.....	600	.0090	.0010	
93,906	650	.0102	.....	
101,129	700	.0113	.....	
108,353	750	.0123	.....	
115,576	800	.0137	.....	
122,800	850	.0144	.....	
130,023	900	.0159	.....	
137,247	950	.0173	.....	
144,470	1,000	.0194	.0022	
				E (600-1,000)=2,174,000 pounds per square inch.

No. 1852—Continued.

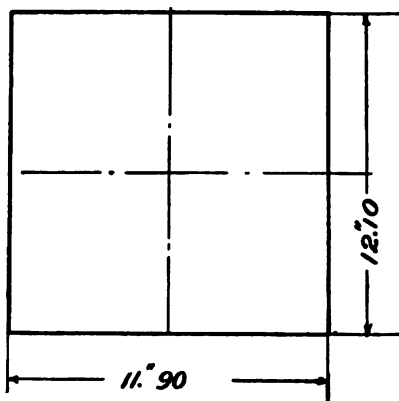
Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
.....	600	.0111	.0022	
.....	600	.0110	.0022	
158,917	1,100	.0213	.....	
173,364	1,200	.0237	.....	
187,811	1,300	.0260	.....	
202,258	1,400	.0287	.....	
216,705	1,500	.0314	.0039	
.....	600	.0144	.0039	
.....	600	.0144	.0039	
231,152	1,600	.0343	.....	
245,599	1,700	.0378	.....	
260,046	1,800	.0403	.....	
274,493	1,900	.0434	.....	
288,940	2,000	.0466	.0072	E (1,000-2,000) = 2,252,000 pounds per square inch.
.....	600	.0203	.0071	
.....	600	.0202	.0071	
303,387	2,100	.0534	.....	
317,834	2,200	.0561	.....	
332,281	2,300	.0602	.....	
346,728	2,400	.0649	.....	
361,175	2,500	.0736	.0211	
.....	600	.0351	.0210	
.....	600	.0346	.0208	
375,622	2,600	.0852	.....	
390,069	2,700	.0931	.....	
404,516	2,800	.....	.....	Ultimate strength.

Opened oblique cracks about 9" from upper end of column.

No. 1853.

1: 1 Mortar.

Plain column, without reënforcing metal.



Composition, by volume: Saylor's Portland cement, 1; sand (10-mesh sieve), 1.

Age, set in air, 9 months 28 days.

Weight of column, total, 1,043 pounds.

Weight of concrete, 1,043 pounds = 130.8 pounds per cubic foot.

Height of column, 95.70 inches.

Sectional area, $11'' \times 12'' = 143.99$ square inches.

Gauged length, 50''.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	Pounds.	Inch.	Inch.	
14,399	100	0.	0.	Initial load. Loaded with 9,000 pounds before testing.
21,599	150	.0009	.0001	
28,798	200	.0018	.0002	
35,998	250	.0027	.0002	
43,197	300	.0036	.0003	
50,397	350	.0047	.0004	
57,596	400	.0059	.0005	
64,796	450	.0068	.0005	
71,995	500	.0082	.0007	
79,195	550	.0089	.0008	
86,394	600	.0100	.0009	E (100-600) = 2,747,000 pounds per square inch.
.....	600	.0100	.0009	
93,594	650	.0112	.....	
100,793	700	.0124	.....	
107,993	750	.0134	.....	
115,192	800	.0145	.....	
122,392	850	.0157	.....	
129,591	900	.0169	.....	
136,791	950	.0183	.....	
143,990	1,000	.0196	.0021	E (600-1,000) = 2,381,000 pounds per square inch.
.....	600	.0118	.0021	
.....	600	.0117	.0019	
158,389	1,100	.0217	.....	
172,788	1,200	.0241	.....	
187,187	1,300	.0264	.....	
201,586	1,400	.0287	.....	
215,985	1,500	.0311	.0033	

No. 1853—Continued.

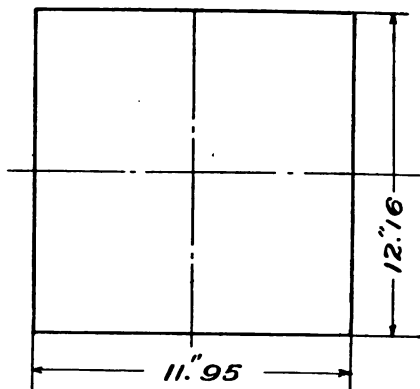
Applied loads.		In gauged lengths.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
.....	600	.0131	.0032	
.....	600	.0131	.0032	
230,384	1,600	.0332	.....	
244,783	1,700	.0355	.....	
259,182	1,800	.0377	.....	
273,581	1,900	.0403	.....	
287,980	2,000	.0429	.0054	E (1,000-2,000)—2,500,000 pounds per square inch.
.....	600	.0155	.0052	
.....	100	.....	.0040	Set after resting under initial load $\frac{1}{2}$ hour.
.....	600	.0142	.0041	
302,379	2,100	.0455	.....	
316,778	2,200	.0483	.....	
331,177	2,300	.0510	.....	
345,576	2,400	.0538	.....	
359,975	2,500	.0568	.0080	
.....	600	.0185	.0079	
.....	600	.0185	.0079	
487,000	3,382	.....	.....	Ultimate strength.

Column failed $2\frac{1}{2}$ feet from upper end. Opened oblique cracks.

No. 1854.

1 : 2 Mortar.

Plain column, without reënforcing metal.



Composition, by volume: Saylor's Portland cement, 1; sand (10-mesh sieve), 2.

Age, set in air, 10 months 13 days.

Weight of column, total, 1,020 pounds.

Weight of concrete, 1,020 pounds = 126.3 pounds per cubic foot.

Height of column, 96.03 inches.

Sectional area, $11'' .95 \times 12'' .16 = 145.31$ square inches.

Gauged length, 50''.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i> 14,531	<i>Pounds.</i> 100	<i>Inch.</i> 0.	<i>Inch.</i> 0.	Initial load. Loaded with 8,000 pounds before testing.
21,797	150	.0011	0.	
29,062	200	.0022	.0001	
36,328	250	.0033	.0001	
43,593	300	.0043	.0003	
50,859	350	.0070	.0006	
58,124	400	.0066	.0006	
65,390	450	.0077	.0007	
72,655	500	.0088	.0007	
79,921	550	.0099	.0008	
87,186	600	.0110	.0009	
.....	.....	.....	.0008	
.....	600	.0109	.0009	
.....				
94,452	650	.0120		E (100-600)=2,475,000 pounds per square inch. Set after resting 1 hour.
101,707	700	.0132	.....	
108,963	750	.0144	.....	
116,248	800	.0158	.....	
123,514	850	.0171	.....	
130,779	900	.0184	.....	
138,045	950	.0198	.....	
145,310	1,000	.0212	.0023	
.....				
.....	600	.0123	.0022	
.....	600	.0123	.0022	
.....				
159,841	1,100	.0237		E (600-1,000)=2,273,000 pounds per square inch.
174,372	1,200	.0268	.....	
188,903	1,300	.0300	.....	
203,434	1,400	.0326	.....	
217,965	1,500	.0356	.0050	

No. 1854—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
-----	600	.0154	.0048	
	600	.0155	.0048	
232,496	1,600	.0390	-----	
247,027	1,700	.0424	-----	
261,558	1,800	.0467	-----	
276,089	1,900	.0503	-----	
290,620	2,000	.0538	.0096	E (1 000-2,000)=1,976,000 pounds persquare inch.
-----	600	.0212	.0096	
-----	600	.0211	.0095	
375,400	2,583	-----	-----	Ultimate strength.

Column failed 2 feet from upper end, developing oblique pyramidal fracture and longitudinal fissure.

TABULATION OF COMPRESSIVE STRENGTH OF CONCRETE AND MORTAR COLUMNS, PLAIN AND REINFORCED.

Height of columns 8 feet, approximately.

No. of test.	Composition.				Age.		Reinforcing metal.		Sectional areas.			Weight of concrete or mortar per cubic foot.	Compressive strength.	
	Ce-ment.	Sand.	Stone.	Kind of stone.	Mos.	Days.	Description.	Metal in longi- tudinal bars.	Gross.	Concrete or mortar.	Bars.		Total.	Per square inch on gross sectional area.
	Inches.							Per cent.	Sq. in.	Sq. in.	Sq. in.	Pounds.	Pounds.	
1834	1	2½	5	½" gravel.	7		12 ½" bars	2.37	96.26	96.90	2.36	134.5	215,000	2,166
1835	1	2½	5	do.	7		do.	2.35	100.06	97.70	2.36	131.1	191,400	1,913
1836	1	2½	5	do.	7		do.	2.39	98.60	96.24	2.36	132.2	212,600	2,156
1837	1	2½	5	do.	7		do.	2.41	97.65	95.29	2.36	134.9	223,000	2,284
1838	1	2	4	½" to ¾" trap rock.	7		None.		144.00			144.7	274,000	1,907
1839	1	1½	3	do.	7		do.		144.24			144.2	333,000	2,323
1840	1	1	2	do.	7		do.		143.74			144.1	498,000	3,406
1841	Neat cement.				7		do.		84.30				445,000	5,279
1842	1	2	3½	¾" to 1" trap rock.	7	17	* 3 wire helix, 1" pitch.		82.62			147.4	390,000	4,720
1843	1	2	4	do.	7	22	4 ¾" Kahn bars.	1.56	143.64	141.30	2.25	146.5	390,000	2,589
1844	1	2	4	do.	7	24	do.	1.57	143.04	140.70	2.25	145.4	390,500	2,604
1845	1	1½	3	do.	7	23	do.	1.57	143.26	141.03	2.25	145.2	346,000	2,415
1846	1	1½	3	do.	8	20	do.	1.56	144.84	142.59	2.25	144.7	333,132	2,300
1847	1	2	4	do.	8	21	8 ½" Kahn bars.	1.37	144.24	142.24	2.00	141.9	259,632	1,900
1848	1	2	4	do.	8	24	do.	1.38	144.12	142.12	2.00	142.8	273,300	1,967
1849	1	1½	3	do.	8	25	do.	1.38	144.11	142.11	2.00	142.5	370,000	2,568
1850	1	1½	3	do.	8	26	do.	1.38	144.83	142.83	2.00	147.4	390,000	2,968
1851	1	1	2	do.	9	2	do.	1.38	144.71	142.71	2.00	149.7	491,000	3,383
1852	1	1	2	do.	9	6	do.	1.38	144.47	142.47	2.00	145.5	404,516	2,900
1853	1	1	.....	.....	9	28	None.		143.99			130.8	487,000	3,382
1854	1	2	.....	.....	10	13	do.		145.31			126.3	375,400	2,583

BRICK.

**COMPRESSION TESTS OF BRICK CONTRIBUTED
BY MEMBERS OF THE NATIONAL BRICK
MANUFACTURERS' ASSOCIATION
OF THE UNITED STATES
OF AMERICA.**

BRICK.

Compressed surfaces faced with plaster of paris to secure even bearings in the testing machine.

Marks.	From—	Description.	Dimensions.			Sectional area.	First crack.	Compressive strength.	
			Height.	Compressed surface.				Total.	Per square inch.
			Inches.	Inches.	Inches.	Sq. ins.	Pounds.	Pounds.	Pounds.
10 A	The Canton Pressed Brick Co., Canton, Ohio.	Buf.	2.40	4.07	8.49	34.55	204,600	258,600	7,490
10 B	do.	do.	2.39	4.03	8.46	34.09	302,800	321,900	9,440
10 C	do.	do.	2.40	4.03	8.49	34.21	227,800	404,400	11,820
11 A	do.	Dark red.	2.29	3.88	8.16	31.66	403,100	476,500	14,630
11 B	do.	do.	2.30	3.85	8.15	31.38	418,900	451,800	14,400
11 C	do.	do.	2.31	3.86	8.16	31.50	419,200	483,900	15,340
1 A	Hydraulic-Press Brick Co., Washington Branch, Washington, D. C.	Red face brick. Color No. 8.	2.33	4.03	8.24	33.21	216,000	283,500	8,537
1 B	do.	do.	2.37	4.03	8.28	33.37	256,000	279,000	8,361
1 C	do.	do.	2.37	4.02	8.28	33.29	249,000	255,000	7,640
2 A	do.	Light chocolate, mottled, face brick. Color No. 58.	2.35	3.96	8.19	32.68	279,000	401,000	12,270
2 B	do.	do.	2.26	4.02	8.17	32.84	415,000	449,000	14,280
2 C	do.	do.	2.28	4.01	8.20	32.88	410,000	449,000	13,640
3 A	do.	Light buff, mottled, face brick. Color No. 79.	2.27	4.04	8.08	32.64	180,000	367,000	17,370
3 B	do.	do.	2.31	4.04	8.07	32.60	425,000	605,000	18,560
3 C	do.	do.	2.30	4.02	8.07	32.44	408,000	604,000	18,620
4 A	do.	Light buff, mottled, face brick. Color No. 149.	2.31	3.90	8.12	31.69	498,000	598,000	18,900
4 B	do.	do.	2.35	3.91	8.13	31.83	430,000	630,000	20,420
4 C	do.	do.	2.30	3.96	8.14	32.23	410,000	608,000	18,860
5 A	Coffeyville Vitrified Brick and Tile Co., Independence, Kans.	Red. Grade 1. Shade 5. Branded "Coffeyville."	2.48	4.16	8.44	35.11	198,000	237,000	6,750
5 B	do.	do.	2.48	4.15	8.37	34.74	220,000	272,000	6,390
5 C	do.	do.	2.48	4.15	8.37	34.74	209,000	260,000	6,020
6 A	do.	Red. Grade 1. Shade 10. Branded "Coffeyville."	2.49	4.21	8.45	35.57	182,000	220,000	6,180
6 B	do.	do.	2.48	4.20	8.45	35.49	250,000	266,000	7,500
6 C	do.	do.	2.46	4.17	8.45	35.24	270,000	273,000	7,750
7 A	do.	Red paving brick. Branded "Coffeyville," "V. B. & T. Co.," Tested on edge.	4.27	2.32	8.59	19.93	94,000	121,000	6,070
7 B	do.	do.	4.30	2.41	8.70	20.97	94,000	111,500	5,320
7 C	do.	do.	4.23	2.43	8.70	21.14	99,000	109,900	5,200

8	A	do	Red paving brick. Branded "Cof'y v'le." "Vit. B. & T. Co., Tested on edge.	3.91	2.18	8.38	18.27	70,000	188,000	10,290
8	B	do	do	3.92	2.18	8.28	18.05	41,000	176,500	9,780
8	C	do	do	3.93	2.17	8.34	18.10	54,000	182,000	10,060
9	A	do	Red paving block. Branded "Cof'y v'le." "Vit. B. & T. Co., Tested on edge.	3.87	3.06	8.47	25.92	198,000	368,000	14,200
9	B	do	do	3.92	3.04	8.33	25.32	145,000	355,000	14,020
9	C	do	do	3.87	3.07	8.37	25.70	156,000	444,000	17,280
12	A	do	Red shale brick, burnt with natural gas.	2.87	3.91	8.00	31.28	320,000	504,000	16,110
12	B	do	do	2.40	4.00	8.06	32.24	280,000	361,000	11,200
12	C	do	do	2.40	3.96	8.01	31.72	298,000	320,000	10,060
13	A	do	do	2.37	3.99	8.00	31.80	405,000	499,000	15,630
13	B	do	do	2.37	3.96	7.99	31.92	299,000	610,000	19,180
13	C	do	do	2.38	3.99	8.00	31.92	410,000	572,000	17,920
14	A	do	Dark-red, No. 9.	2.36	3.96	8.20	32.47	101,000	476,000	14,660
14	B	do	do	2.30	3.92	8.17	32.03	135,000	533,000	16,640
14	C	do	do	2.34	3.92	8.20	32.14	198,000	553,000	17,210
15	A	do	Dark-red, No. 10.	2.34	3.96	8.16	32.46	130,000	598,000	18,410
15	B	do	do	2.31	3.97	8.14	32.32	260,000	583,000	18,040
15	C	do	do	2.30	3.97	8.16	32.40	235,000	508,000	15,680
16	A	do	Red, I.	2.30	3.96	8.23	32.59	290,000	499,000	15,310
16	B	do	do	2.30	3.93	8.26	32.46	145,000	437,000	13,460
16	C	do	do	2.31	3.92	8.31	32.58	265,000	356,000	10,990
17	A	do	Red, II.	2.28	3.98	8.29	32.99	295,000	380,000	11,520
17	B	do	do	2.27	3.93	8.23	32.34	250,000	369,000	11,410
17	C	do	do	2.30	4.00	8.33	33.32	360,000	432,000	12,970
18	A	do	Light-salmon, III.	2.33	4.21	8.64	36.37	158,000	193,000	5,310
18	B	do	do	2.33	4.20	8.58	36.04	179,000	209,000	5,800
18	C	do	do	2.34	4.21	8.63	36.04	172,000	212,500	5,860
19	A	do	Red, wire cut.	2.21	3.92	7.96	28.45	88,000	361,000	12,690
19	B	do	do	2.22	3.60	7.84	28.22	76,000	336,000	11,910
19	C	do	do	2.26	3.59	7.87	28.25	74,000	294,000	10,410
20	A	do	Dark-brown building brick.	2.32	3.56	7.46	26.56	91,000	765,000	28,500
20	B	do	do	2.33	3.52	7.67	27.00	75,000	731,000	27,070
20	C	do	do	2.30	3.55	7.66	27.19	73,000	664,000	24,420
21	A	do	Paving brick, tested on edge.	4.06	2.60	9.17	23.84	71,000	320,000	13,420
21	B	do	do	4.06	2.63	9.20	24.20	99,000	271,000	11,200
21	C	do	do	4.10	2.67	9.32	24.88	93,000	246,500	9,910
22	A	do	do	4.00	3.50	9.73	34.06	108,000	446,000	13,090
22	B	do	do	4.00	3.46	9.84	34.24	85,000	407,000	11,890
22	C	do	do	4.10	3.46	9.78	33.84	89,000	399,000	11,790
23	A	do	Paving brick, tested on edge. Branded "Shawmut, Pa."	3.89	3.01	8.36	26.67	155,000	396,000	14,350
23	B	do	do	3.85	2.98	8.86	26.40	177,000	376,000	14,240
23	C	do	do	3.89	3.02	8.88	26.82	186,000	411,500	15,340
24	A	do	Paving block, tested on edge. Top block from Eudaly kln.	3.92	3.27	8.65	28.29	73,000	230,000	8,130
24	B	do	do	3.94	3.28	8.64	28.34	88,000	216,000	7,620
24	C	do	do	3.90	3.27	8.63	28.22	87,000	305,000	10,810

BRICK—Continued.

Compressed surfaces faced with plaster of paris to secure even bearings in the testing machine.

Marks.	From—	Description.	Dimensions.			Sectional area.	First crack.	Compressive strength.	
			Height.	Compressed surface.				Total.	Per square inch.
				Inches.	Inches.				
24 A	T. B. Townsend Brick and Contracting Co. Zanesville, Ohio.	Paving brick, tested on edge. Center block from Eudaly kiln.	3.84	3.31	8.64	28.60	Pounds. 72,000	Pounds. 428,000	Pounds. 14,970
24 B	do.	do.	3.85	3.28	8.65	28.37	115,000	329,000	11,000
24 C	do.	do.	3.87	3.22	8.65	27.85	91,000	292,000	9,410
24 A	do.	Dark-red paving block, tested on edge. Bottom block from Eudaly kiln.	3.87	3.26	8.76	28.56	103,000	271,000	9,460
24 B	do.	do.	3.85	3.28	8.74	28.67	55,000	256,000	8,930
24 C	do.	do.	3.83	3.28	8.75	28.70	86,000	328,000	11,430
25 A	Fernwood Lumber Co., Fernwood, Miss.	Light-red building brick.	2.31	4.17	8.43	35.15	199,000	238,500	6,790
25 B	do.	do.	2.38	4.13	8.37	34.57	214,000	260,800	7,540
25 C	do.	do.	2.34	4.07	8.37	34.07	198,000	286,000	8,800
26 A	The Barr Clay Co., Streator, Ill.	Dark-brown paving brick, tested on edge.	4.00	2.35	8.23	19.34	68,000	379,000	19,000
26 B	do.	do.	3.98	2.28	8.20	18.53	61,000	365,000	19,700
26 C	do.	do.	4.00	2.32	8.18	18.98	52,000	319,000	16,810
27 A	do.	Dark-brown paving block, tested on edge. Branded "Barr."	3.96	3.43	8.30	28.47	99,000	549,500	19,300
27 B	do.	do.	3.96	3.46	8.25	28.55	108,000	497,000	17,410
27 C	do.	do.	3.97	3.45	8.25	28.46	130,000	383,000	13,810
28 A	Illinois Brick Co., Chicago, Ill.	Light-red. Very irregular structure.	2.30	3.55	7.91	28.08	66,000	102,000	3,600
28 B	do.	do.	2.28	3.51	7.74	27.17	42,000	130,500	4,900
28 C	do.	do.	2.26	3.58	7.78	27.85	60,000	148,000	5,310
30 A	Denny-Renton Clay and Coal Co., Seattle, Wash.	Dark-red pressed brick. Shade No. 90.	2.40	4.12	8.41	34.65	280,000	409,000	11,800
30 B	do.	do.	2.40	4.12	8.26	34.03	205,000	543,000	15,960
30 C	do.	do.	2.30	4.12	8.37	34.46	278,000	379,000	10,960
30 A	do.	Gray pressed brick. Shade No. 35.	2.40	4.03	8.33	33.57	290,000	383,500	10,530
30 B	do.	do.	2.40	4.02	8.43	33.89	277,000	286,000	8,440
30 C	do.	do.	2.50	4.02	8.43	33.89	240,000	281,000	8,290
31 A	do.	Cream pressed brick. Shade No. 11.	2.47	4.10	8.34	34.19	216,000	316,000	8,380
31 B	do.	do.	2.47	4.10	8.38	34.36	230,000	347,000	9,190
31 C	do.	do.	2.45	4.15	8.36	34.66	330,000	344,000	9,920
32 A	do.	Dark-red paving brick, tested on edge.	3.86	2.38	8.53	20.30	89,000	323,000	15,910
32 B	do.	do.	3.86	2.38	8.52	20.11	66,000	290,000	14,420
32 C	do.	do.	4.00	2.42	8.49	20.55	82,000	312,000	15,180

SANDSTONE.

COMPRESSION TESTS OF SANDSTONE RECEIVED FROM THE WEST VIRGINIA GEOLOGICAL SURVEY.

Samples were finished on a rubbing bed. The ends were finished flat and tests were made without plaster or other facing.

COMPRESSION TESTS OF SANDSTONE.
FROM KINGS CREEK QUARRY COMPANY.

Marks.	Description.	Dimensions.			Sectional area.	First crack.	Ultimate strength.	
		Height.	Compressed surface.				Total.	square inch.
		<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Sq. ins.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>
A ₁	Top L. Buff.....	3.99	4.00	4.01	16.04	137,200	140,200	8,740
A ₂	First L. Gray.....	3.96	3.99	3.98	15.88	217,500	217,500	13,700
A ₃	First L. Gray.....	3.98	3.98	3.96	15.76	205,500	205,500	13,040
A ₄	Second L. Buff.....	3.91	3.92	3.93	15.41	156,900	156,900	10,180

FROM THE COAL AND COKE RAILWAY, GASSAWAY, W. VA.

Marks.	Description.	Dimensions.			Sectional area.	First crack.	Ultimate strength.	
		Height.	Compressed surface.				Total.	Per square inch.
		<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Sq. ins.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>
B ₁	Dark buff. Coarse grain.....	3.55	3.81	3.81	14.52	101,400	101,400	6,980
B ₁	do.....	3.93	3.98	3.97	15.80	141,000	141,000	8,920
B ₂	Green. Fine grain.....	3.95	3.93	3.93	15.44	193,700	193,700	12,550
B ₂	do.....	3.89	3.93	3.92	15.41	192,400	192,400	12,490
B ₃	Gray. Fine grain.....	3.96	3.99	4.00	15.96	129,900	129,900	8,140
B ₃	do.....	3.92	3.92	3.93	15.41	121,900	121,900	7,910

FROM THE COAL AND COKE RAILWAY, GASSAWAY, W. VA.

Marks.	Description.	Dimensions.			Sectional area.	First crack.	Ultimate strength.	
		Height.	Compressed surface.				Total.	Per square inch.
		<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Sq. ins.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>
C	Gray.....	3.81	3.81	3.79	14.44	169,800	169,800	11,760
C	do.....	3.79	3.79	3.79	14.36	170,400	170,400	11,870
C	do.....	3.96	3.95	3.96	15.64	198,700	198,700	12,700
C	do.....	3.78	3.78	3.78	14.29	200,200	200,200	14,010
C	do.....	3.90	3.90	3.91	15.25	179,600	179,600	11,780
C	do.....	3.88	3.89	3.89	15.13	187,400	187,400	12,390

FROM ELKINS (?), W. VA.

Marks.	Description.	Dimensions.			Sectional area.	First crack.	Ultimate strength.	
		Height.	Compressed surface.				Total.	Per square inch.
		<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Sq. ins.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>
D	Buff.	3.88	3.88	3.88	15.05	98,600	98,600	6,550
D	do.....	4.00	4.00	3.99	15.96	105,000	105,000	6,580

FROM W. H. BATSON & CO. (FORMERLY MOUNTAIN STATE STONE CO.), HUNDRED, W. VA.

Marks.	Description.	Dimensions.			Sectional area.	First crack.	Ultimate strength.	
		Height.	Compressed surface.				Total.	Per square inch.
		<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Sq. ins.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>
3 E	Buff.	3.91	3.96	3.95	15.64	134,200	134,200	8,580
3 E	do.	4.00	4.02	4.00	16.08	139,900	139,900	8,700
3 E	do.	3.98	4.03	4.02	16.20	106,200	106,200	6,560
3 E	do.	3.82	3.81	3.81	14.52	94,000	94,000	6,470
3 E	do.	4.00	4.02	4.02	16.16	139,800	139,800	8,650
3 G	do.	3.92	3.93	3.93	15.44	134,000	134,000	8,680

FROM J. A. CONNELLY, LITTLETON, WETZEL COUNTY, W. VA.

Marks.	Description.	Dimensions.			Sectional area.	First crack.	Ultimate strength.	
		Height.	Compressed surface.				Total.	Per square inch.
		<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Sq. ins.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>
4 H	Buff. (Brown)	3.89	3.88	3.88	15.05	112,200	122,000	8,110
4 H	do.	3.72	3.80	3.80	14.44	89,000	97,000	6,720
4 H	do.	3.86	3.87	3.87	14.98	119,800	119,800	8,000
4 H	do.	3.77	3.79	3.79	14.36	110,600	110,600	7,700
4 H	do.	3.85	3.85	3.85	14.82	105,000	105,000	7,090
4 H	do.	3.82	3.82	3.82	14.59	117,100	117,100	8,030
4 I	Gray (Blue)	3.82	3.82	3.81	14.55	197,200	197,200	13,550
4 I	do.	3.82	3.82	3.83	14.63	192,600	192,600	13,160
4 I	do.	3.83	3.82	3.82	14.59	205,000	206,000	14,120
4 I	do.	3.64	3.63	3.63	13.18	199,800	199,800	15,160
4 I	do.	3.65	3.65	3.65	13.32	111,200	111,200	8,350
4 I	do.	3.80	3.79	3.84	14.55	119,000	121,000	8,320
4 I	do.	3.78	3.81	3.81	14.52	119,200	119,200	8,210

FROM HOOVER & KINNEAR, MURRAYVILLE, W. VA.

Marks.	Description.	Dimensions.			Sectional area.	First crack.	Ultimate strength.	
		Height.	Compressed surface.				Total.	Per square inch.
		<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Sq. ins.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>
C	Buff.....	3.99	3.99	3.99	15.92	65,200	65,200	4,100
C	do.....	3.88	3.88	3.88	15.05	74,500	74,500	4,950
C	do.....	5.93	5.91	5.92	34.99	169,200	169,200	4,840
C	do.....	8.00	8.01	8.00	64.08	463,000	463,000	7,230

FROM GEORGES CREEK COAL AND IRON CO.

Marks.	Description.	Dimensions.			Sectional area.	First crack.	Ultimate strength.	
		Height.	Compressed surface.				Total.	Persquare inch.
		<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>				
7 J	Buff. Fine grained ..	2.75	3.77	3.79	14.29	128,000	128,600	9,000
7 J	do.	3.76	3.78	3.73	14.10	135,200	135,200	9,590
7 J	do.	3.73	3.78	3.74	14.14	105,000	125,400	8,870
7 J	Buff. Coarse grained.	3.91	3.89	3.87	15.05	119,800	119,800	7,960
7 J	do.	3.81	3.88	3.87	15.02	117,400	117,400	7,820
7 J	do.	3.85	3.82	3.87	14.86	122,000	122,900	8,270
7 J	Gray.....	3.77	3.82	3.86	14.75	169,700	169,700	11,510
7 K	do.	3.88	3.96	3.93	15.56	181,000	181,000	11,680
7 K	do.	3.90	3.93	3.96	15.56	163,000	170,900	10,980
7 K	do.	3.97	3.93	3.94	15.48	149,000	165,700	10,700
7 K	do.	3.94	3.94	3.95	15.56	164,500	164,500	10,570
7 K	do.	3.90	3.93	3.91	15.37	161,600	161,600	10,510

FROM QUARRY OWNED BY HON. ARTHUR G. DAYTON, PHILIPPI, W. VA.

Marks.	Description.	Dimensions.			Sectional area.	First crack.	Ultimate strength.	
		Height.	Compressed surface.				Total.	Persquare inch.
		<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Sq. ins.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>
L 8	Buff.....	3.90	3.89	3.91	15.21	147,000	165,800	10,900
L 8	do.....	3.91	3.91	3.92	15.33	172,000	180,200	11,750
L 8	do.....	3.91	3.90	3.89	15.17	182,000	197,500	13,020
L 8	do.....	3.88	3.99	4.00	15.96	201,000	207,000	12,970
L 8	do.....	3.98	4.01	4.01	16.08	194,000	205,300	12,770
L 8	do.....	3.97	3.99	3.99	15.92	179,000	202,500	12,720

FROM JAMES D. CRUMP, NEAR ALDERSON, W. VA.

Marks.	Description.	Dimensions.			Sectional-area.	First crack.	Ultimate strength.	
		Height.	Compressed surface.				Total.	Per square inch.
		<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Sq. ins.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>
M 10	Brown.....	3.85	3.90	3.90	15.21	356,000	356,000	23,410
M 10	do.....	3.94	3.96	3.98	15.76	299,000	392,500	24,900
M 10	do.....	3.96	3.97	3.98	15.80	374,000	375,500	23,770
M 10	do.....	3.97	3.98	3.97	15.80	371,000	373,000	23,610
M 10	do.....	3.90	3.96	3.95	15.64	258,000	258,000	16,500
M 10	do.....	3.96	3.98	3.98	15.84	354,500	354,500	22,380

FROM C. D. MERRICK, PARKERSBURG, W. VA.

Marks.	Dimensions.			Sectional area.	First crack.	Ultimate strength.	
	Height.	Compressed surface.				Total.	Per square inch.
	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Sq. ins.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>
.....	3.97	3.98	4.00	15.92	127,300	132,400	8,320
.....	3.95	4.00	4.00	16.00	86,500	89,900	5,620
.....	3.99	4.00	4.05	16.20	95,500	99,700	6,150
.....	4.00	4.00	4.03	16.12	89,100	91,300	5,660

Pyramidal fractures.

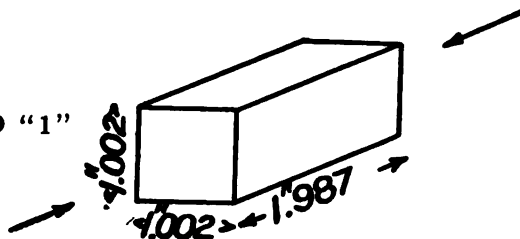
CHILLED CAST IRON.

MATERIAL RECEIVED FROM BUREAU OF STANDARDS,
WASHINGTON, D. C.

**COMPRESSION TESTS OF CHILLED CAST-IRON SPECIMENS FOR THE
BUREAU OF STANDARDS, WASHINGTON, D. C.**

Compression measurements taken from face to face of compression platforms of the testing machine.

MARKED "1"

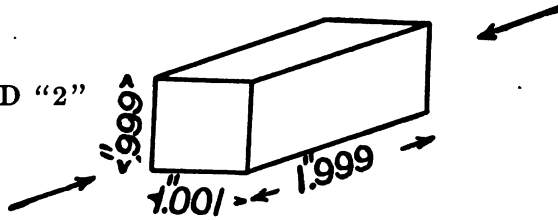


MEAN SECTIONAL AREA, 1.004 SQUARE INCH.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
1,004	1,000	0.	0.	Initial load.
5,020	5,000	.0007		
10,040	10,000	.0016		
15,060	15,000	.0024		
20,080	20,000	.0031		
25,100	25,000	.0036		
30,120	30,000	.0043	— .0005	
35,140	35,000	.0048		
40,160	40,000	.0053		
45,180	45,000	.0058		
50,200	50,000	.0065	— .0005	
50,200	50,000	.0065	— .0005	
Compression platforms changed.				Micrometer reset at 0.
1,004	1,000	0.	0.	
50,200	50,000	.0058		
60,240	60,000	.0069		
70,280	70,000	.0081		
80,320	80,000	.0097		
90,360	90,000	.0118		
95,380	95,000	.0131		
100,400	100,000	.0143	.0021	
50,200	50,000	.0080		
100,400	100,000	.0147		
110,440	110,000	.0209		
135,800	135,260			Ultimate strength.

Opened oblique shearing cracks along one end of specimen, opposite end apparently unaffected by the test.

MARKED "2"



MEAN SECTIONAL AREA, 1 SQUARE INCH.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
<i>Pounds.</i>	<i>Pounds.</i>	<i>Inch.</i>	<i>Inch.</i>	
.....	1,000	0.	0.	Initial load.
.....	10,000	.0014	.....	
.....	20,000	.0031	.....	
.....	30,000	.0048	.....	
.....	40,000	.0070	.0012	
.....	45,000	.0088	.....	
.....	50,000	.0109	.0036	
.....	50,000	.0111	.0040	
Compression platforms changed.				
.....	1,000	0.	0.	Micrometer reset at 0.
.....	50,000	.0069	.....	
.....	55,000	.0084	.....	
.....	60,000	.0112	.....	
.....	65,000	.0143	.....	
.....	70,000	.0182	.0084	
.....	75,000	.0221	.....	
.....	80,000	.0268	.....	
.....	85,000	.0322	.....	
.....	90,000	.0390	.0252	
.....	95,000	.0471	.....	
.....	100,000	.0590	.0432	
.....	110,200	.....	.....	Ultimate strength.

Opened oblique shearing cracks along one end of specimen, opposite end apparently unaffected by the test.

WIRE STRANDS CLAMPED WITH WIRE-ROPE CLIPS.

**MATERIAL RECEIVED FROM UNITED STATES
ENGINEER CORPS, MEMPHIS, TENN.**

WIRE STRANDS CLAMPED WITH WIRE-ROPE CLIPS.

Nuts on clips tightened, using a 6-inch wrench.

Style of clips and number.	Size of wire strands.	Tensile resistance.	
		Pounds.	Pounds.
2 Old Style Crosby $\frac{1}{4}$ ".....	$\frac{1}{4}$ " and $\frac{1}{4}$ ".....	1,850	2,540
2 New Style Crosby $\frac{1}{4}$ ".....	$\frac{1}{4}$ " and $\frac{1}{4}$ ".....	1,420	1,850
2 Cincinnati High Guard $\frac{1}{4}$ ".....	$\frac{1}{4}$ " and $\frac{1}{4}$ ".....	1,900	2,550
2 Cincinnati Low Guard $\frac{1}{4}$ ".....	$\frac{1}{4}$ " and $\frac{1}{4}$ ".....	2,100	.....
Galvanized:			
2 Cincinnati High Guard $\frac{1}{4}$ ".....	$\frac{1}{4}$ " and $\frac{1}{4}$ ".....	2,700	.....
2 Cincinnati Low Guard $\frac{1}{4}$ ".....	$\frac{1}{4}$ " and $\frac{1}{4}$ ".....	3,280	.....
2 Old Style Crosby $\frac{1}{4}$ ".....	$\frac{1}{4}$ " and $\frac{1}{4}$ ".....	2,200	2,450
2 Old Style Crosby $\frac{1}{4}$ ".....	$\frac{1}{4}$ " and $\frac{1}{4}$ ".....	2,550	(a)
2 Old Style Crosby $\frac{1}{4}$ ".....	$\frac{1}{4}$ " and $\frac{1}{4}$ ".....	3,200	b 3,600
2 New Style Crosby $\frac{1}{4}$ ".....	$\frac{1}{4}$ " and $\frac{1}{4}$ ".....	1,900	2,200
2 Cincinnati Low Guard $\frac{1}{4}$ ".....	$\frac{1}{4}$ " and $\frac{1}{4}$ ".....	1,300	.....
Galvanized: 2 Cincinnati Low Guard $\frac{1}{4}$ ".....	$\frac{1}{4}$ " and $\frac{1}{4}$ ".....	1,600	.....
2 Old Style Crosby $\frac{1}{4}$ ".....	$\frac{1}{4}$ " and $\frac{1}{4}$ ".....	2,740	(c)
2 New Style Crosby $\frac{1}{4}$ ".....	$\frac{1}{4}$ " and $\frac{1}{4}$ ".....	1,980	.....
2 Cincinnati Low Guard $\frac{1}{4}$ ".....	$\frac{1}{4}$ " and $\frac{1}{4}$ ".....	1,320	.....
Galvanized: 2 Cincinnati Low Guard $\frac{1}{4}$ ".....	$\frac{1}{4}$ " and $\frac{1}{4}$ ".....	1,720	.....

a Fractured $\frac{1}{4}$ " strand.

b Two wires fractured.

c $\frac{1}{4}$ " strand fractured.

Under the heading "Tensile resistance" there are two columns of results. It was found in some cases, after the clips had been drawn together, that a higher resistance was encountered than that which was necessary to start a movement of the wire strands. When this second maximum resistance occurred, the figures indicating same are shown in the second column.

MONEL METAL.

MONEL METAL.

Length of samples 9.50 inches to 12 inches long.

How rolled.	Dimensions.		Sectional area.	Tensile strength.		Elongation in 2 inches.		Area at fracture.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
	Width, diameter.	Thickness.		Total.	Per square inch.	Inch.	Per cent.				
Hot rolled	Inches.	Inch.	Sq. inch.	Pounds.	Pounds.	Inch.	Per cent.	Inch.	Per cent.	"	Brownish gray.
Do.....	1.0162	.0213	.0216	1,570	72,690	.33	16.5	.955 × .017 = .0162	25.0	.13, .20*	Do.
Do.....	.0209	.0209	.0211	1,512	57,310	.17	8.5	.920 × .018 = .0166	17.4	.06, .12*	Do.
Do.....	1.0152	.0212	.0215	1,540	71,630	.28	14.	.960 × .018 = .0171	20.5	.14, .14	Do.
Cold rolled	1.0122	.0254	.0257	1,884	73,310	.46	23.	.910 × .021 = .0191	28.7	.21, .25*	Do.
Do.....	1.0122	.0255	.0258	1,882	72,950	.43	21.5	.915 × .021 = .0192	28.6	.20, .25*	Do.
Do.....	1.0222	.0252	.0258	1,872	72,560	.42	21.	.915 × .021 = .0192	28.6	.22, .20	Do.

SHOT LINES.

MATERIAL RECEIVED FROM UNITED STATES
LIFE-SAVING SERVICE.

SHOT LINES.

Taper shot line No. 7.

Waterproofed.

Length between pins, 3 feet.

No. of coil.	Diameter of line.	End of coil tested.	Tensile strength.	Parted.
	<i>Inch.</i>		<i>Pounds.</i>	
1	.15	Inside.....	174	At the pin.
1	.15	do.....	175	Do.
1	.21	Outside.....	378	8" from the pin.
1	.21	do.....	375	12" from the pin.
2	.22	Inside.....	360	At the pin.
2	.22	do.....	335	Do.
2	.22	do.....	329	Do.
2	.15	Outside.....	176	Do.
2	.15	do.....	170	Do.
3	.15	Inside.....	174	6" from the pin.
3	.15	do.....	184	At the pin.
3	.22	Outside.....	280	Do.
3	.22	do.....	346	Do.
3	.22	do.....	327	Do.

RUBBER.

TENSILE TESTS OF RUBBER.

Length of samples over all, about 6 inches.
Elongations measured on gauged length of 2".

Marks.	Description.	Dimensions.		Sectional area.	Tensile strength.		Elongation in 2".		Set after elongation of 3".
		Width.	Thick-ness.		Total.	Per square inch.			
		Inch.	Inch.	Sq. in.	Pounds.	Pounds.	Inches.	Per ct.	Inch.
.85 No. 1		.62	.50	.310	230	710	6.60	330	.....
Do.		.62	.53	.329	215	653	6.70	335	.15
.85 No. 2		.66	.50	.340	236	694	6.40	320	.....
Do.		.64	.50	.320	225	703	6.80	340	.20
(None)		.70	.53	.371	280	755	6.40	320	.....
Do.		.68	.52	.354	255	720	6.40	320	a. 20

LOT "A." VULCANIZED AND ROLLED AT WATERTOWN ARSENAL.

.60	Not ground.....	.61	.50	.305	191	626	5.80	290	.....
.60	do.....	.63	.50	.315	196	629	4.50	225	.05
.60	Ground on bottom side.....	.57	.45	.257	143	556	4.00	230	.....
.60	Ground on top and bottom.....	.64	.44	.282	143	507	4.00	200	.....

LOT "B." VULCANIZED AND ROLLED AT WORKS OF STOWE & WOODWARD, CAMPELLO, MASS.

.60	Not ground.....	.49	.48	.235	102	434	3.45	172.5	.....
.60	Ground on bottom side.....	.50	.42	.210	100	476	3.80	190	.....
.60	do.....	.50	.42	.210	105	500	4.15	207.5	.....
.60	Ground on top and bottom.....	.53	.37	.196	106	541	4.50	225	.....

LOT "C." VULCANIZED AND ROLLED AT WORKS OF STOWE & WOODWARD, CAMPELLO, MASS.

.85	Not ground.....	.49	.50	.245	215	878	6.75	337.5	.....
.85	Ground on bottom side.....	.52	.44	.229	222	969	6.85	342.5	.....
.85	do.....	.49	.43	.211	198	938	6.75	337.5	.....
.85	Ground on top and bottom.....	.51	.38	.194	200	1,031	7.05	352.5	.....

RUBBER TAKEN FROM WHEELS.

Dark..	.....	.50	.42	.210	131	624	5.10	255	.....
Do.	.....	.50	.42	.210	126	600	4.40	220	.....
Do.	.....	.50	.41	.205	116	566	4.15	207.5	.....
Do.	.....	.50	.41	.205	112	546	5.20	260	.....
Light..	.....	.58	.33	.191	46	241	3.20	160	.....
Do.	.....	.58	.33	.191	52	272	3.80	190	.....
Do.	.....	.53	.33	.175	38	217	2.20	110	.....
Do.	.....	.53	.33	.175	41	234	2.60	130	.....

a Set after five minutes' rest, ".20.

**PHOTOGRAPHIC BLUE-PRINT AND
BROWN-PRINT PAPER.**

TENSILE TESTS OF PHOTOGRAPHIC BLUE-PRINT AND BROWN-PRINT PAPER.

Specimens received from the Ordnance Department, U. S. Army, Washington, D. C.

Length of specimens over all, 5".

Length of specimens between jaws, 3".

Width of specimens, 1".

Color.	Marks.	Taken out.	Thick- ness.	Sec- tional area.	Tensile strength.				
					Specimens.			Mean.	
					1.	2.	3.	Total.	Per square inch.
Blue...	Technical Supply Co.	Lengthwise	<i>Inch.</i> 0052	<i>Sq. in.</i> 0052	<i>Lbs.</i> 16.00	<i>Lbs.</i> 15.75	<i>Lbs.</i> 15.75	<i>Lbs.</i> 15.83	<i>Lbs.</i> 3,040
Brown...	do.	do.	0031	0031	27.25	28.00	27.00	27.42	8,850
Blue...	J. H. Well & Co.	do.	0051	0051	18.25	17.75	17.50	17.83	3,500
Brown...	do.	do.	0027	0027	10.50	10.00	10.25	10.25	3,800
Blue...	American Blue-Print Paper Co.	do.	0033	0033	12.50	12.75	12.25	12.50	3,790
Brown...	do.	do.	0027	0027	12.50	12.75	12.75	12.67	4,660
Blue...	Keuffel & Esser Co.	do.	0042	0042	30.00	29.25	29.00	29.42	7,000
Brown...	do.	do.	0036	0036	16.50	15.25	15.25	15.67	4,350
Blue...	Dietzgen's Co.	do.	0049	0049	14.25	16.00	15.75	15.33	3,130
Brown...	do.	do.	0036	0036	12.25	13.25	12.50	12.67	3,520
Blue...	N. Y. Blue-Print Paper Co.	do.	0031	0031	22.50	22.25	.....	22.38	7,220

TENSILE TESTS OF SAME PAPER AFTER HAVING BEEN DEVELOPED AT WATERTOWN ARSENAL.

Color.	Marks.	Taken out.	Thick- ness.	Sec- tional area.	Tensile strength.			
					Specimens.		Mean.	
					1	2.	Total.	Per square inch.
Blue...	Technical Supply Co.	Lengthwise	<i>Inch.</i> 0053	<i>Sq. in.</i> 0053	<i>Lbs.</i> 15.25	<i>Lbs.</i> 16.00	<i>Lbs.</i> 15.63	<i>Lbs.</i> 2,950
Brown...	do.	do.	0032	0032	23.00	24.75	23.88	7,460
Blue...	J. H. Well & Co.	do.	0052	0052	16.25	17.50	16.88	3,250
Brown...	do.	do.	0028	0028	10.25	10.75	10.50	3,750
Blue...	American Blue-Print Paper Co.	do.	0034	0034	12.25	12.00	12.13	3,570
Brown...	do.	do.	0028	0028	11.75	10.75	11.25	4,020
Blue...	Keuffel & Esser Co.	do.	0044	0044	26.25	28.75	27.50	6,250
Brown...	do.	do.	0037	0037	24.25	23.75	24.00	6,490
Blue...	Dietzgen's Co.	do.	0051	0051	13.75	14.50	14.13	2,770
Brown...	do.	do.	0037	0037	12.00	11.75	11.88	3,210
Blue...	N. Y. Blue - Print Paper Co.	do.	0032	0032	21.75	.....	21.75	6,800

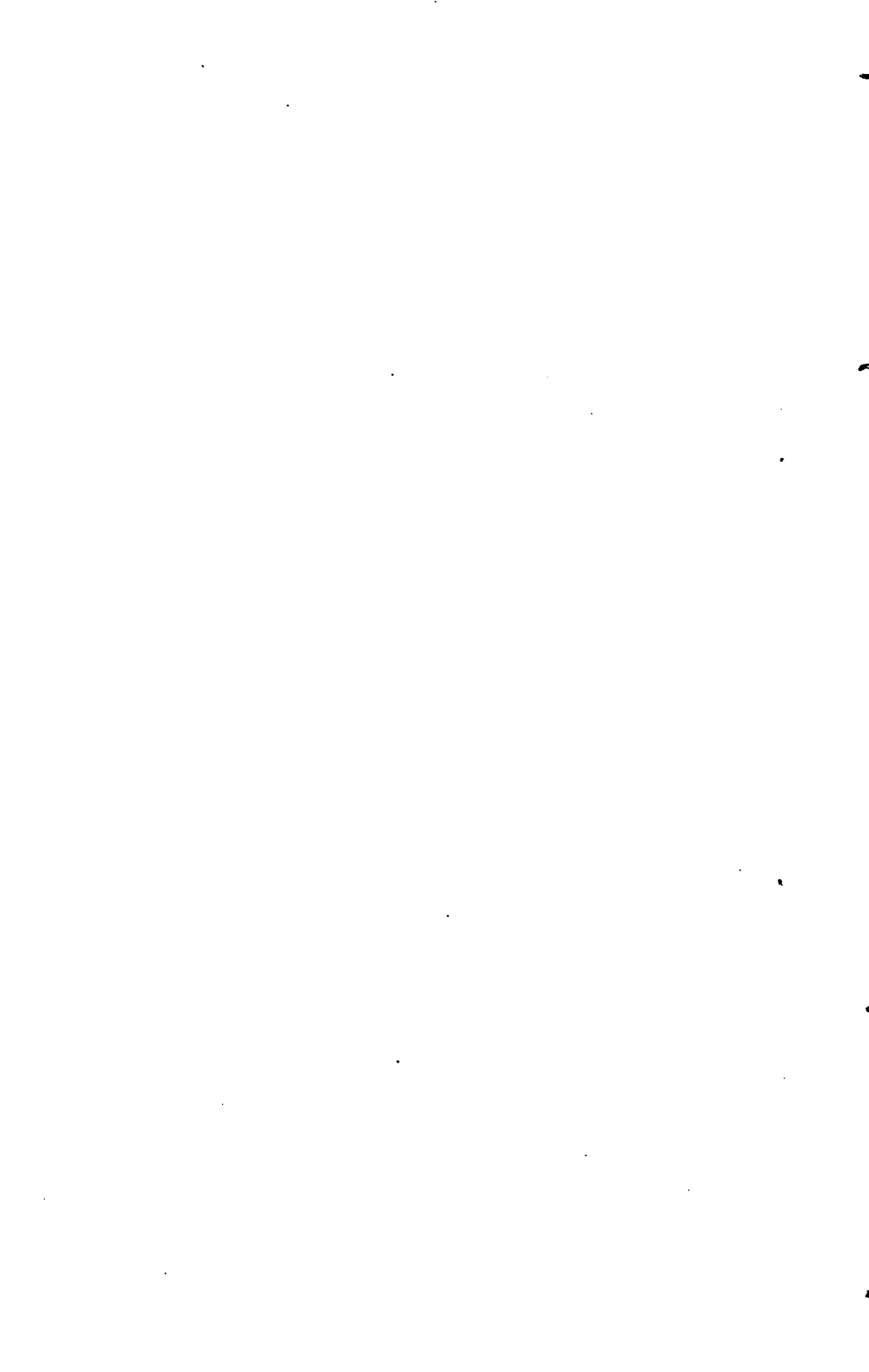
PRIVATE TESTS.

Tests made for private parties during the fiscal year ended June 30, 1908.

Date.	Material.	Name.	City and State.
1907.			
July 1	Steel specimens.....	The Wyman & Gordon Co.....	Worcester, Mass.
3	Cast iron.....	The Davis & Farnum Manufacturing Co.....	Waltham, Mass.
3	Steel specimens.....	The Wyman & Gordon Co.....	Worcester, Mass.
5	Manila rope.....	Columbian Rope Co.....	Auburn, N. Y.
11	Cast iron.....	The Davis & Farnum Manufacturing Co.....	Waltham, Mass.
12	Steel specimens.....	The Wyman & Gordon Co.....	Worcester, Mass.
13	do.....	do.....	Do
17	Cement brick.....	Plymouth Cordage Co.....	Plymouth, Mass.
17	Granite.....	The T. A. Gillespie Co.....	Granite Quarry, N. C.
17	Cubes and briquettes.....	Merrimac Chemical Co.....	North Woburn, Mass.
19	Concrete block.....	J. R. Worcester.....	Boston, Mass.
19	Concrete.....	Boston Transit Commission.....	Do
20	Cast iron.....	The Davis & Farnum Manufacturing Co.....	Waltham, Mass.
24	Concrete paving blocks.....	Simpson Bros. Corporation.....	Boston, Mass.
24	Wire rope.....	Carson Trench Machine Co.....	Charlestown, Mass.
26	do.....	do.....	Do
26	Steel specimens.....	Savage Arms Co.....	Utica, N. Y.
26	do.....	The Wyman & Gordon Co.....	Worcester, Mass.
Aug. 1	Bronze specimens.....	Victor Metals Co.....	East Braintree, Mass.
5	Steel specimens.....	Savage Arms Co.....	Utica, N. Y.
5	do.....	Boston Elevated Railway Co.....	Boston, Mass.
5	do.....	The Wyman & Gordon Co.....	Worcester, Mass.
7	Cast iron.....	The Davis & Farnum Manufacturing Co.....	Waltham, Mass.
10	Bronze specimens.....	Victor Metals Co.....	East Braintree, Mass.
13	Cement building blocks.....	Salterelli Bros.....	Buffalo, N. Y.
15	Steel specimens.....	The Wyman & Gordon Co.....	Worcester, Mass.
16	do.....	General Electric Co.....	Schenectady, N. Y.
17	Concrete.....	Sherman & Edwards.....	Boston, Mass.
17	Marble.....	John G. Kerr.....	Denver, Colo.
19	Aluminum specimens.....	Hood Rubber Co.....	East Watertown, Mass.
19	Nickel-steel tubing.....	General Electric Co.....	West Lynn, Mass.
19	Cast-iron cap.....	United States Column Co.....	Cambridge, Mass.
19	Lally patent columns.....	do.....	Do
20	do.....	do.....	Do
21	do.....	do.....	Do
27	Concrete.....	Sherman & Edwards.....	Boston, Mass.
27	Bronze.....	J. S. MacFarland.....	New London, Conn.
29	Wrought iron.....	B. M. Jones & Co., Inc.....	Boston, Mass.
Sept. 4	Steel.....	Portland Iron and Steel Co.....	South Portland, Me.
6	Concrete.....	Sherman & Edwards.....	Boston, Mass.
7	Bronze specimens.....	Victor Metals Co.....	East Braintree, Mass.
9	Rating hydraulic gauge.....	The Ashcroft Manufacturing Co.....	Bridgeport, Conn.
9	Steel specimens.....	The Wyman & Gordon Co.....	Worcester, Mass.
10	do.....	do.....	Do
10	Wire rope.....	Carson Trench Machine Co.....	Charlestown, Mass.
16	Concrete.....	Boston Transit Commission.....	Boston, Mass.
17	Paper cores.....	Spaulding & Tewksbury Co.....	Do
17	Concrete.....	Sherman & Edwards.....	Do
19	Manila rope.....	State of New York.....	Albany, N. Y.
26	Steel specimens.....	The Wyman & Gordon Co.....	Worcester, Mass.
Oct. 2	do.....	do.....	Do
7	Wrought-iron bar.....	R. E. Glancy.....	Waltham, Mass.
10	Steel specimens.....	The Wyman & Gordon Co.....	Worcester, Mass.
12	Hooks and swivels.....	The Thomas Laughlin Co.....	Portland, Me.
14	Links and shackles.....	do.....	Do
19	Concrete cubes.....	Sherman & Edwards.....	Boston, Mass.
25	Steel specimens.....	Savage Arms Co.....	Utica, N. Y.
26	do.....	The Wyman & Gordon Co.....	Worcester, Mass.

Date.	Material.	Name.	City and State.
1907.			
Oct. 28	Granite cubes and bricks.	Pittsburg Testing Laboratory	Pittsburg, Pa.
29	Bricks and chimney tiles.	do.	Do.
30	Cement building blocks.	D. J. Donovan Co.	Buffalo, N. Y.
30	do.	Janssen & Bartz.	Do.
30	do.	William Rycroft.	Do.
Nov. 2	do.	The International Manufacturing Co.	Do.
5	Canvas belting.	Boston Woven Hose Co.	Cambridge, Mass.
5	Harness leather.	Pfister & Vogel Co.	Milwaukee, Wis.
6	do.	do.	Do.
7	Steel plate.	Geo. H. Barrus.	Boston, Mass.
9	Steel specimens.	The Wyman & Gordon Co.	Worcester, Mass.
11	Steel bars.	Portland Iron and Steel Co.	South Portland, Me.
13	Steel specimens.	The Wyman & Gordon Co.	Worcester, Mass.
14	Manila rope.	Standard Cordage Co.	Boston, Mass.
16	Steel specimens.	The Wyman & Gordon Co.	Worcester, Mass.
19	Wire rope.	G. & W. Manufacturing Co.	New York, N. Y.
22	Cast-iron shelf supports.	The Sneed & Co. Iron Works.	Jersey City, N. J.
29	Cement-filled columns.	John J. Tresidder.	Brooklyn, N. Y.
30	Lally columns.	The American Thread Co.	Holyoke, Mass.
Dec. 4	Concrete.	J. R. Worcester.	Boston, Mass.
4	Manila rope.	Columbian Rope Co.	Auburn, N. Y.
4	Steel specimens.	The Wyman & Gordon Co.	Worcester, Mass.
4	Steel bars.	Wheelock, Lovejoy & Co.	Boston, Mass.
9	Rubber belting.	Revere Rubber Co.	Chelsea, Mass.
10	Copper specimens.	C. H. Tyler.	Boston, Mass.
13	Cast iron and bronze.	The Davis & Farnum Manufacturing Co.	Waltham, Mass.
17	Steel specimens.	Savage Arms Co.	Utica, N. Y.
17	Harness leather.	Pfister & Vogel Co.	Milwaukee, Wis.
23	Steel specimens.	The Wyman & Gordon Co.	Worcester, Mass.
24	do.	do.	Do.
26	Welded steel plates.	Merrimac Chemical Co.	North Woburn, Mass.
31	Steel specimens.	The Wyman & Gordon Co.	Worcester, Mass.
1908.			
Jan. 2	Paving brick.	The Saxton Vitrified Brick Co.	Saxton, Pa.
6	Lally columns.	United States Column Co.	Boston, Mass.
9	Copper specimens.	C. H. Tyler.	Do.
9	Steel specimens.	Savage Arms Co.	Utica, N. Y.
14	do.	The Wyman & Gordon Co.	Worcester, Mass.
15	do.	do.	Do.
16	Concrete building blocks.	John H. Jax Co.	Buffalo, N. Y.
16	Concrete building block.	Paul Vogt & Sons.	Everett, Mass.
16	Concrete building blocks.	John Haeusser.	Buffalo, N. Y.
16	Brick.	Pittsburg Testing Laboratory	Pittsburg, Pa.
17	Manila rope.	American Manufacturing Co.	New York, N. Y.
21	Steel specimens.	The Wyman & Gordon Co.	Worcester, Mass.
22	Wrought-iron plates.	Merrimac Chemical Co.	North Woburn, Mass.
27	Tire steel.	The Edward Stinson Manufacturing Co.	Baltimore, Md.
27	Hooks and links.	The Thomas Laughlin Co.	Portland, Me.
28	Manila rope.	Columbian Rope Co.	Auburn, N. Y.
30	Steel specimens.	The Wyman & Gordon Co.	Worcester, Mass.
Feb. 1	Hydraulic gauge.	Star Brass Manufacturing Co.	Boston, Mass.
2	Steel specimens.	The Wyman & Gordon Co.	Worcester, Mass.
4	Steel wire rope.	Duplex Metals Co.	New York, N. Y.
4	Harness leather.	Pfister & Vogel Co.	Milwaukee, Wis.
7	Concrete building blocks.	The Armstrong Concrete Specialty Co.	Boston, Mass.
10	Steel specimens.	Savage Arms Co.	Utica, N. Y.
10	do.	The Wyman & Gordon Co.	Worcester, Mass.
13	Cotton duck.	J. H. Lane & Co., Inc.	Boston, Mass.
18	Steel specimens.	The Wyman & Gordon Co.	Worcester, Mass.
20	Buoy shackles.	The Fletcher & Crowell Co.	Portland, Me.
21	do.	do.	Do.
21	Riveted plate.	T. R. Lawson.	Troy, N. Y.
24	Buoy shackles.	The Fletcher & Crowell Co.	Portland, Me.
26	Wrought iron.	do.	Do.
28	Steel specimens.	The Wyman & Gordon Co.	Worcester, Mass.
Mar. 2	Wrought iron.	The Fletcher & Crowell Co.	Portland, Me.
2	Steel.	Wheelock, Lovejoy & Co.	Boston, Mass.
5	Steel specimens.	The Wyman & Gordon Co.	Worcester, Mass.
6	Cast iron.	The Davis & Farnum Manufacturing Co.	Waltham, Mass.

Date.	Material.	Name.	City and State.
1908.			
Mar. 6	Cement-filled columns.	Fireproof Column Company of America.	Jersey City, N. J.
9	Manila rope.	Standard Cordage Co.	Boston, Mass.
9	Wrought iron.	The Fletcher & Crowell Co.	Portland, Me.
13	Steel specimens.	The Wyman & Gordon Co.	Worcester, Mass.
14	do.	do.	Do.
14	do.	Savage Arms Co.	Utica, N. Y.
17	do.	The Wyman & Gordon Co.	Worcester, Mass.
17	Cast iron.	Hartford Laboratory Co.	Hartford, Conn.
21	Granite.	Maguire & O'Heron.	East Milton, Mass.
24	Steel specimens.	The Wyman & Gordon Co.	Worcester, Mass.
25	Concrete.	Armory Commissioners State of Massachusetts.	Boston, Mass.
25	do.	C. C. Burns.	Watertown, N. Y.
25	Marble.	Meadow Marble Co.	Cincinnati, Ohio.
25	Concrete building blocks.	John H. Jax Co.	Buffalo, N. Y.
25	do.	The Approved Concrete Co.	Do.
26	Lally column.	United States Column Co.	Boston, Mass.
26	Rail braces.	Boston Elevated Railway Co.	Do.
26	Cast iron.	The Davis & Farnum Manufacturing Co.	Waltham, Mass.
31	Cast-iron levers.	E. & T. Fairbanks & Co.	St. Johnsbury, Vt.
Apr. 2	Wrought-iron bar.	Houghton & Richards.	Boston, Mass.
2	Steel specimens.	The Wyman & Gordon Co.	Worcester, Mass.
16	Chains.	A. J. Wilkinson & Co.	Boston, Mass.
21	Cement.	Wm. R. Warren.	New York, N. Y.
22	Concrete.	Sherman & Edwards.	Boston, Mass.
22	Canvas belting.	Ruboll-Belting Co.	Do.
22	Manila rope.	Detroit Shipbuilding Co.	Detroit, Mich.
23	Steel specimens.	The Wyman & Gordon Co.	Worcester, Mass.
24	Cast iron.	The Davis & Farnum Manufacturing Co.	Waltham, Mass.
27	Ford columns.	United States Column Co.	Boston, Mass.
27	Cast-iron shelf supports.	The Sneed & Co. Iron Works.	Jersey City, N. J.
30	Steel specimens.	Savage Arms Co.	Utica, N. Y.
30	do.	The Baldwin Steel Co.	Charleston, W. Va.
May 5	Concrete.	A. A. Elston & Co.	Boston, Mass.
7	Rating hydraulic gauges.	The Ashcroft Manufacturing Co.	Bridgeport, Conn.
7	Manila rope and copper wire.	Boston Elevated Railway Co.	Boston, Mass.
8	Cast-iron scale lever and steel link.	The Fairbanks Co.	Do.
9	Steel bars.	Wheelock, Lovejoy & Co.	Do.
9	Manila rope.	Standard Cordage Co.	Do.
18	Cast iron.	The Davis & Farnum Manufacturing Co.	Waltham, Mass.
18	Steel specimens.	The Wyman & Gordon Co.	Worcester, Mass.
19	Steel eye bars.	The Phoenix Iron Co.	Phoenixville, Pa.
21	Cotton rope.	The Lee Hotel Fire Escape Co.	Poughkeepsie, N. Y.
21	Shackles.	The Fletcher & Crowell Co.	Portland, Me.
22	do.	do.	Do.
23	Manila rope.	Boston Elevated Railway Co.	Boston, Mass.
23	Cast iron.	The Davis & Farnum Manufacturing Co.	Waltham, Mass.
23	Steel specimens.	The Wyman & Gordon Co.	Worcester, Mass.
23	Concrete cylinders.	J. R. Worcester & Co.	Boston, Mass.
25	do.	do.	Do.
25	Concrete building blocks and brick.	Dix D. Drake.	Buffalo, N. Y.
27	Cast iron.	The Davis & Farnum Manufacturing Co.	Waltham, Mass.
June 24	Steel specimens.	Savage Arms Co.	Utica, N. Y.
25	do.	Cape Ann Tool Co.	Pigeon Cove, Mass.
25	Concrete building blocks.	John H. Jax.	Buffalo, N. Y.
27	Building bricks.	New England Brick Co.	Boston, Mass.
27	Concrete cylinders.	Sanford E. Thompson.	Newton Highlands, Mass.
29	do.	do.	Do.
29	Steel wire.	Stanley Motor Carriage Co.	Newton, Mass.
30	Cement building block.	Haverhill Cement Stone Co.	Haverhill, Mass.
30	Steel specimens.	The Wyman & Gordon Co.	Worcester, Mass.



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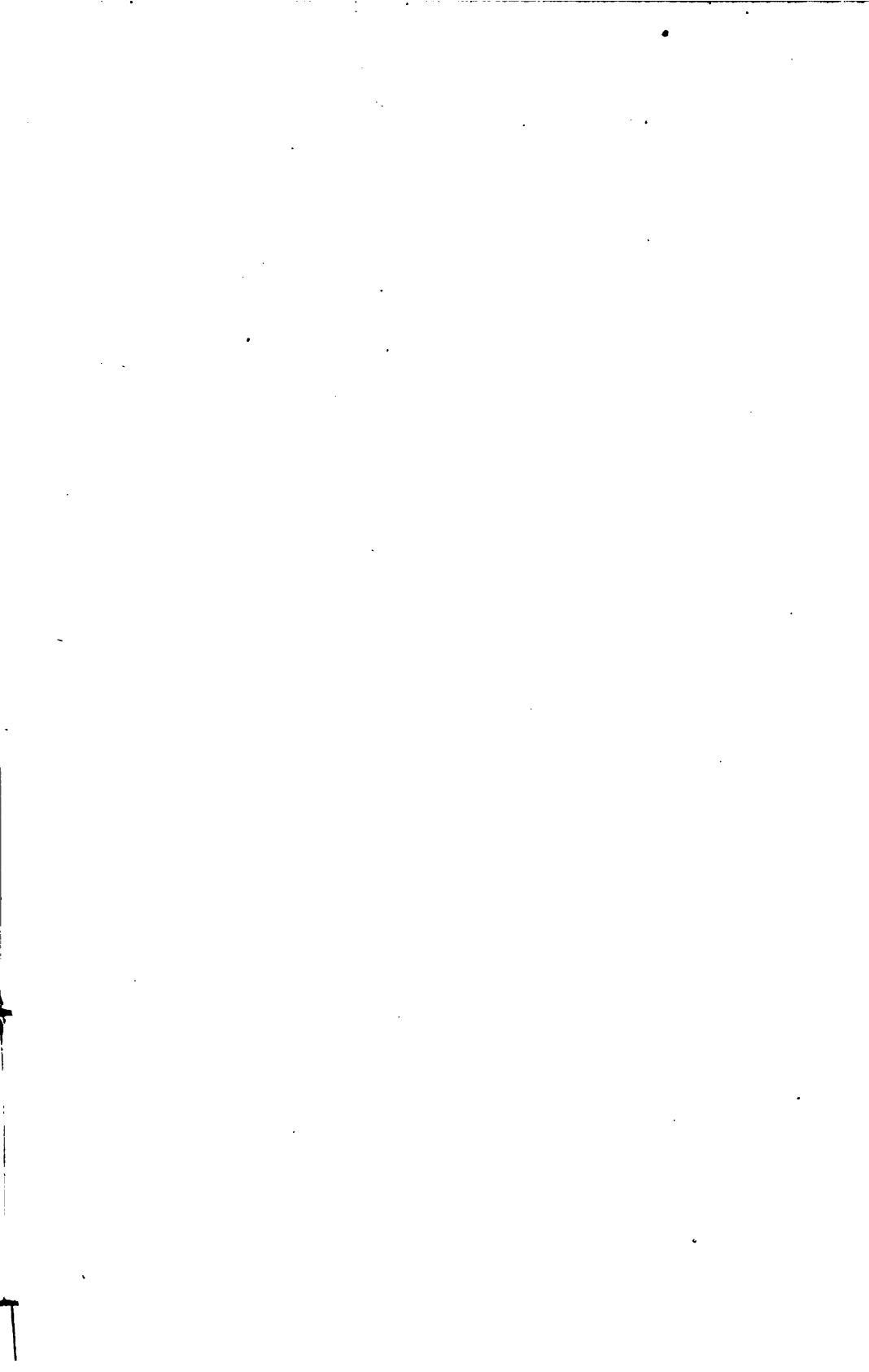
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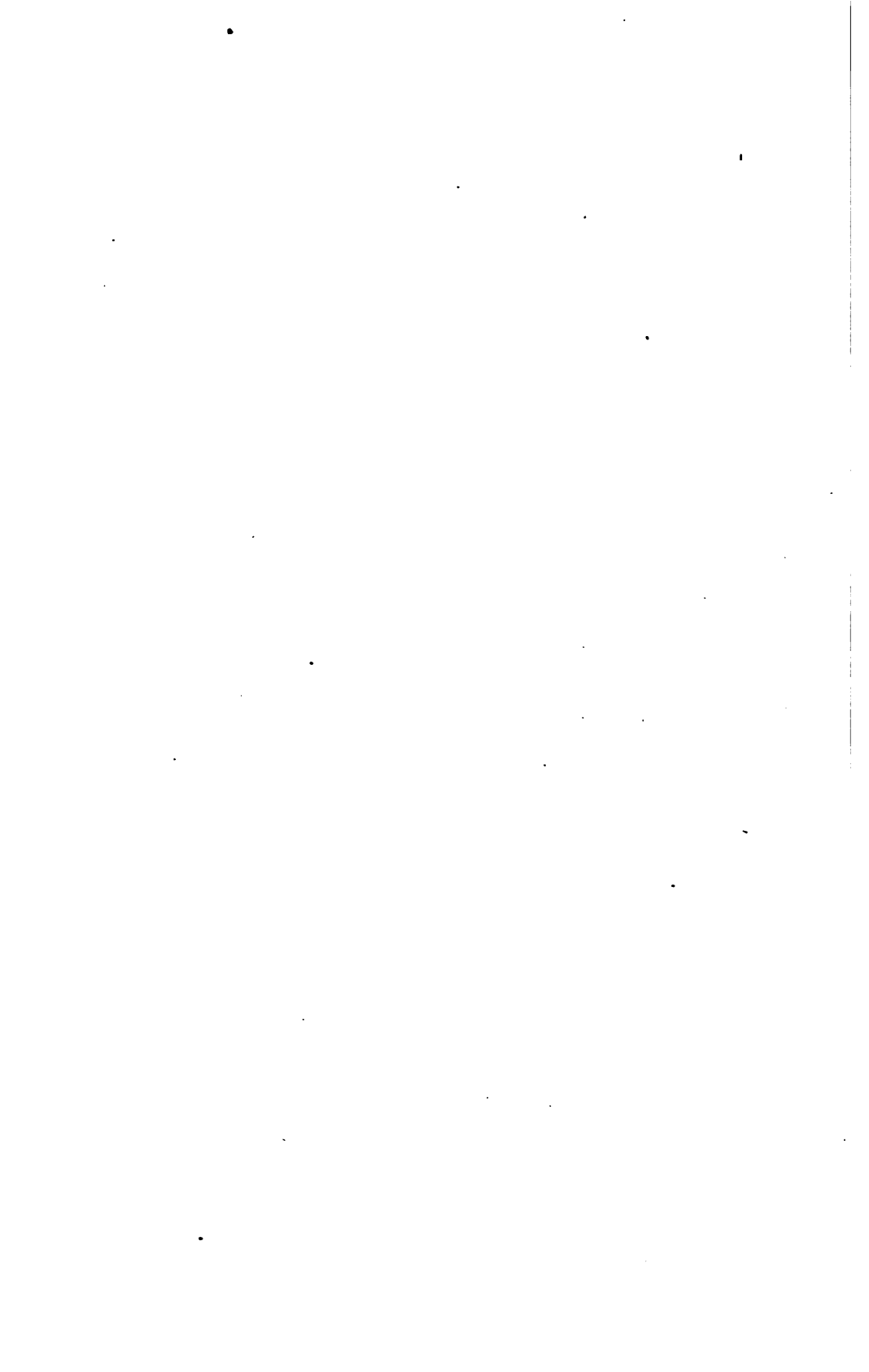
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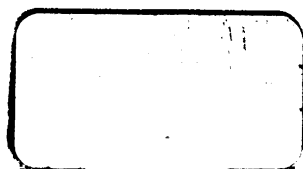
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